Interview with Kenneth M. Heilman, MD
American Academy of Neurology
Oral History Project

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Interviewed by Heidi L. Roth, MD
with Barbara W. Sommer, BWS Associates

Interviewed in Doctor Heilman's Office and in the Library
of the Department of Neurology, University of Florida Medical Center,
Gainesville, Florida

Interviewed on November 4, 2013

Kenneth M, Heilman -KH
Heidi L. Roth - HR
Barbara W. Sommer - BWS

BWS: Today is November 4, 2013, and we are interviewing Doctor Kenneth Heilman for the American Academy of Neurology [AAN] Oral History Project at the University of Florida Medical Center.

Doctor Heilman is the James E. Rooks, Jr. Distinguished Professor of Neurology and Health Psychology Program Director and [former] Chief of Neurology at the Northwestern Florida/South Georgia Veterans Affairs Medical Center, and he is director for the Center for Neuropsychological Studies and Behavior Neurology Dementia Post-Doctoral Program at the University of Florida College of Medicine, which has trained more than seventy post-doctoral fellows. He is director of the Cognitive and Memory Disorder Clinic and the University of Florida Alzheimer's Disease Center, Director of the Memory Disorders Clinic at the University of Florida/Shands, which is one of the memory disorder clinics supported by the University of Florida Department of Elder Affairs, and founder of the Society of Behavioral and Cognitive Neurology. He is the winner of the Behavioral and Cognitive Neurology Outstanding Achievement Award and its Lifetime Achievement Award. He is a member and fellow of the AAN and winner of the AAN Wartenberg Award.

The interviewers are Doctor Heidi Roth, who held a post-doctoral fellowship at the Behavior and Cognitive Neurology Program at the University of Florida, and Barbara W. Sommer.

HR: If there are errors in the transcript, we can make corrections. In the final transcript, I go through everything.

KH: May I make a comment?

HR: Yes.

KH: I'm no longer the chief of the…. I'm former chief.

BWS: This is sort of a formal/informal process, so go ahead and say whatever you need to say.

KH: I'm OCD [obsessive-compulsive disorder] after all these years.

[chuckles]

HR: I wanted to start chronologically and start with Brooklyn in New York. I hear about that when we're talking about things, and I think that may reveal something about your character. Where you grew up influences you kind of early on. So do you want to say a few words about growing up in Brooklyn in the 1940s and 1950s?

KH: Yes, okay. I grew up where I was born in Brooklyn. I was born in a neighborhood called Borough Park and actually almost all my schools, high school and junior high, were in Bensonhurst. There were three major ethnic groups that were there, more than three but it was about one-third Italian, one-third Jewish, and the other third was a combination of Norwegians, Irish, and Scots. It was all Caucasian. Everybody got along amazingly well. It was very, very close.

As a boy growing up, I always loved sports, so I spent a huge amount of time on the streets playing stickball, kick the can, trying stoop ball, and a lot of other sports like that. It was just a wonderful place to grow up, actually.

Some of the schools I went to had some tough characters and there were the usual gangs and so forth. Luckily, early in my life, I learned not to let anybody bully me, so I was never bullied all during that time.

I was very fortunate in high school. It turns out that many of the teachers in my high school actually had Ph.D.s. They got their Ph.D.s during the Depression. There were no jobs so they became teachers. I just had a wonderful education in elementary, middle, and high school. It was just absolutely superb with superb teachers. I had superb friends. It was really just a wonderful period of my life.

[Note: video begins here]

HR: Do you want to say anything about your family and how they influenced you at that time in your life?

KH: That's a hard thing to really know.

It was interesting because very early in my life, I remember I wasn't a good sleeper and my mother would put the lights out when it was time to go to bed. I would lay in bed. We lived about a half a block from an elevator subway line called the Old West End Line and I would hear them go past all through the night. I remember saying, "I have to find a job that would allow me to stay up all through the night." I said, "You, know, maybe medicine would be good that way." Then, when I was an intern at Cornell [University Medical Center], Bellevue and I was up all through the night, I said, "Boy, I lived out my dream. Was it the right thing to do or was this a mistake?"

[chuckles]

KH: The other thing is my mom was always very sensitive. I remember when I was a boy one of the heels came off my shoes. There was a new shoe repair shop. I said, "I'm going to go to the new repair shop and get a heel put on." My mother said, "No, you're going to go to the old man who is still working in that shop, because he's not making enough money. He's suffering. You'll want to give him your business." So my mother, more than anybody, had this real sensitivity about people suffering. She also had—I think I inherited this from her—almost like a…I'm going to use the word philosophic misery. What is life all about? What can you do? It was interesting. I remember even as a boy back then whenever somebody, a friend or a family [member] died, she would not send flowers or anything else. She would always make a contribution to the society that was doing research in that. She said, "The best thing I can do to honor them is to prevent future people from getting that."

I think one of the reasons I picked medicine was the idea if you're going to make life meaningful, what else better can you do to stop suffering than go into medicine? So even in high school if you open my yearbook and it says what people want to do, it turns out, I said, "I want to do medical research." That's in my high school yearbook. So I always had that thing. I thought that could make life really meaningful, to do research and do medicine. So that was always one of my goals. I think that really came from my mother's kind of philosophy and her interest more than anything else.

HR: Did your father influence you in any way, in your character or personality?

KH: Yes. As a kid, I had a bad temper. I got that from my father.

[laughter]

KH: My father was a big sports fan. In fact, one of the stories I tell is he got bladder cancer—he was working even at the age of ninety-three—and it was metastatic, and he was dying. He was in the New York Hospital. I went up to him and I said, "Dad, is there anything you want me to do, anything important that you have left undone or something I can do for you?" He looked up at me and he said, "You can go downstairs and get the *New York Times*. Let me know how the Yankees did."

[laughter]

KH: That was my dad. He loved sports. It turns out that throughout my life, I guess my psychotherapy has always been sports, so I've always been active. I got that from him, in some sense. I think it was his kind of psychotherapy through life. You talked about holding the door for you. My dad was always a gentleman. He also would try to help people whenever he could. So he was like that.

But I think it was my mom who really led me into medicine more than anybody else that I can say.

BW: Doctor Heilman, would you give us the names of your parents?

KH: My mom's name was Roslyn Heilman. Her maiden name was Golin, G-o-l-i-n. My father's name was Samuel Heilman.

HR: Do you want to mention anything about your siblings?

KH: I had one brother. My brother was the best brother anybody could ever want. He always had tremendous love for me. He was a very gentle person, always very interested in my schoolwork. So, for example, when I went looking at colleges, he was the one who drove me there. He was always interested in how I'm doing. My dad lost his business when I was in college and my mother would send me money and my brother, even though he was really young, would send me money, also. So he was always very supportive. It was great. The University of Virginia [U-VA] gave me a scholarship. I went through medical school, even as an out-of-state student, on a full scholarship because he had lost his business. My brother was always so supportive and very loving.

BW: And his name?

KH: His name is Fred. He, also, had the same philosophy: he loved sports.

HR: You referenced sometimes books you read in high school. You said your teachers were really outstanding. Do you want to mention a couple of those formative kinds of books that kind of influenced where you wanted to go?

KH: Let me go back a little bit and say this much.

HR: Yes.

KH: I was left back in the third grade. Because I was left back in third grade, I was still going to high school when I was eighteen. [chuckles] I'm not sure what it was. I didn't realize this, but I do remember [the teacher] giving us a reading test and the teacher would keep on saying—my teacher had a special teacher—"You're not reading what it says in the book." What I would do is read it quickly and then explain what it said. When they had spelling bees, the teacher would always say, "Kenny, there's no sense you even getting up. Just stay seated."

[chuckles]

KH: What was interesting is that back then, it wasn't an IQ test, but to see if you could progress, almost like what they give now, it was mainly reading and spelling and stuff like that, so they left me back.

When I got to middle school, some teacher came in and said, "Some of you are having problems reading. I'm here to help people learn to read." I said, "No, I can read. It's okay."

[laughter]

KH: When I was in high school, I had a Spanish teacher, Mrs. [Lena] Grossman, who was one of the nastiest people in the whole entire world. She would have us read in Spanish. I would come against words and I'd say, "I don't know how to say this word." She'd say, in Spanish, "It's not like English. Every letter has one sound. So there's no excuse for you not being able to read it." She kept on giving me 55's in Spanish and saying, "You're not college material."

Back then, to graduate with an academic degree, you needed three years of a foreign language. What happened—I never did this—is I had my mother go in and see the department chairman and say, "Let him take the regents exam. If he passes it, give him credit." He had a smile like there's no way Heilman is ever going to pass this with all his 55's. I got a very high grade because all it was was reading and answering questions. That I could do. I just couldn't get up and speak it.

Then what happened was years later. Patricia, my wife, is a speech pathologist, and she was teaching kids who were dyslexic and she had a list of twenty-nine words, and she said, "Read these." I said, "You'll have to tell me how to say them so I can read them." It turns out—I never knew it—I was a phonological dyslexic. That's why I had a problem.

The opposite of Mrs. Grossman, and the person to whom I dedicated one of my books, was Mister Abraham Goodman. He was my geometry teacher. I remember in the class going up—there was me and two other women who knew how to spell and did great in Spanish—and he said, "I'm going to give you a theorem. I want you to do it on the board." I said, "Oh, here goes. I'm going to embarrass myself terribly." I wrote out the whole theorem, blah, blah, blah, blah. It came to the end, the conclusions, and then you sit down. Mine was the only one. They didn't have anything. He looked at it and said, "Ken, that is great. That is not in your book. You couldn't have memorized that." The two women didn't since it wasn't in the book. So he was really amazed about my thinking.

Fortunately, when I decided to go to college, I had a college advisor and, it turns out, it was Mister Goodman. So when I came down, he said to me, "Oh, there'll be no problem.

Where do you want to go to college?" I said, "My first choice is University of Virginia, because I love reading about [Thomas] Jefferson." He said, "That won't be any problem." They had your whole life in these little things called Delaney cards. He looks at it and my high school average was in the 70's because I had all these 55's. He said, "Something's wrong here. This is a really strange thing." It also had some estimated IQ, which was also very low. [laughter] He said, "Something's wrong here." I also wanted to take the test for City College [New York]. I didn't have a high enough grade to go to CCNY. So I took that test and he said, "Boy, you did great on this." Then, I took the old College Board Test and he said, "Any place you want to go, you let me know. You'll be able to go there." So he wrote letters to those places and they accepted me and, as I said, even on a scholarship at the University of Virginia.

HR: Great.

KH: The thing I loved about Mister Goodman, and the reason I dedicated it, is because it was the first time in my life, with geometry, of being able to think rather than just regurgitate things back again as you do through schools, the first time anybody really says, "You have a problem; you need to think about it." Even beside the grade, when I was able to solve one of those problems in math and so forth, it was just a wonderful joy…a wonderful joy.

HR: When you look back—you have characteristic traits now and you have a lot of curiosity, creativity, stamina, endless energy—do you feel like that's who you were back then, as well?

KH: I was always very, very curious. In fact, it was interesting because I didn't realize it but some old friends that I grew up with in Brooklyn said, "You made our lives so interesting," because every time we were free, I said, "Let's try this. Let's do this. Let's go here. Let's see this." [chuckles] They reminded me that I was always trying to explore.

I think early on, also, there was something about discovery that always gave me tremendous joy, seeing something new, or reading something new, or hearing new ideas. It was interesting because even back then, there were a lot of problems with addiction in high school and so forth. The only thing I was addicted to was discovery and learning. It really gave me joy.

I really didn't realize that until years later when Bob [Robert T.] Watson was a resident and we did this experiment with the monkeys where we were trying to separate if neglect from frontal lesions was attentional or whether it was action intentional. I looked at the data and the data showed that these monkeys weren't inattentive. They just had a reluctance to act on one side of space. I said to Bob, "Boy, this is *so thrilling*! This is unbelievably exciting. What a *thrill*! What a joy!" He said, "You know, Doctor Heilman, you're kind of weird. That gives you a joy?" I thought about it and I said, "It gives you a joy, also." That's exactly right. It actually gave me a high. To this day, when

we find something new in our studies, guess what? It gives me a high. I think it's going to that ventral striatum as the opium or cocaine or whatever else does.

[chuckles]

KH: I think that's why even the idea of picking professions… When you do neurology and you make a diagnosis, every patient is like an investigation. You're trying to find out what's going on with them. When you come to a conclusion, you're making a discovery. When you really think about why we choose something… If I had decided after medical school to go into ophthalmology, I could have sucked out eight cataracts a day at $3,000 a cataract. Think how much money I'd have now. But the reason I love neurology is because even from the clinical aspect, you're doing an investigation. You're trying to put all these things together and come up with a creative solution. That actually gives you a wonderful internal feeling.

So I was aware of that and Mister Goodman was really the one who first brought that out of me, but my friends always said this thing about exploring and discovery. It was always part of my life…always part of my life.

HR: Very good. I'm only going to ask one more question about your childhood and we'll move on. I wanted to probe a little bit there. The other thing is you said you loved learning and you really had a lot of curiosity in high school. Besides Mister Goodman's class in math, were there other classes that you really enjoyed and got a lot out of?

KH: I loved all the sciences classes, biology classes, and so forth.

Again, I loved reading books. That gave me a tremendous joy and even now. It was interesting. I did this for my kids and my grandkids when they become thirteen. I'm going to give them a list of all these books that they need to read. Yes, the usual: *Catcher in the Rye* and… I was just thinking about one that I read in high school. I can't remember the title. It was Sinclair Lewis.

BW. *Arrowsmith*?

KH: *Arrowsmith*. Thank you. I remember reading that thing about him going to there as a physician. Max [Gottlieb] was his mentor saying, "You have to do a controlled study," and he's saying, "These people are sick. How can I do it?" I read that in high school and it had a tremendous, profound effect. [Martin] Arrowsmith…I just had this *tremendous* empathy with that individual. It was such a meaningful book, so all through high school I was reading stuff like that.

HR: Then you went to the University of Virginia. Tell us a little bit about that. You were there for at least a couple years before you went to medical school.

KH: It turns out actually, believe it or not, when I did medical research, I wanted to do theoretical biochemistry, protein chemistry.

HR: You discovered that when you were at U-VA that you wanted to do that?

KH: Well, no, even when I was in high school. I loved chemistry.

HR: I see.

KH: I knew, even back then, that proteins were so important. I still think that they were very, very important. [chuckles]

I did very well in chemistry at the University of Virginia. I was taking an advanced course with Professor [Robert Eliot] Lutz in advanced organic chemistry. He started giving a lecture where he was talking about quantum mechanics and putting that together with topology. I'm sitting in class and I didn't have the vaguest idea what this man was talking about, I mean, not the *vaguest* idea. I must have had like a puzzled face. A friend of mine was sitting next to me and he said, "What's wrong, Ken?" I said, "Do you understand Professor Lutz?" He said, "Oh, yes, this is really fascinating." He turned to me and he said, "Ken, you mean you don't understand him?" I said, "No." He said, "But you're the one that always gets the A's in the exams."

[laughter]

KH: I said, "That's different."

Actually, after this class, I got kind of depressed because I realized I wanted to be doing research in theoretical protein and disease. So I walked out and I realized I can't do this.

I walked past the medical school—I was in my third year—and I just walked in. The secretary I had known from a party. Her name was Audrey. I said, "Hi, Audrey. What are you doing?" She said, "I'm the secretary at the admissions office." I said, "I'd like to apply for medical school." She said, "Okay. Sit down and fill out these forms." So I filled them out. She made some calls over to the college and so forth. She said, "Let me see if I can get you some interviews."

[chuckles]

KH: She got me some interviews. I said, "But I'm only in my third year." She said, "They're doing an experiment. They're going to take in two third-year students who don't have their college degrees yet. I'm going to have you interview for those." So I had two interviews and, then, she said, "Come back next week and I'll let you know." So I came back next week and she said, "Congratulations. You've been accepted into this program without having the undergraduate degree." But, God! this is really strange.

So later on when I started medical school, these guys were from Ivy League schools and they were all Phi Beta Kappa and I said, "Why did you go into this school?" [chuckles]

Groucho Marx said, "Any county club or any club that has you as a member can't be that good." Because of what happened, I said, "This must be…"

HR: The school.

KH: [chuckles] They all looked at me and said, "Don't you know that U-VA is always ranked in the top of all states? Berkeley-University of California. This has been *the* top university." [laughter]

So I went to medical school and, later on, I realized that was really the right thing for me. You know this, just doing protein chemistry, I think I picked that up because of an ideal. One of the things in clinical medicine still is I've always felt so wanted and privileged to be able to take care of people. That's still, even today, such an important part. So that's how I got to medical school.

HR: You ended up there. At the medical school, were there people that inspired you that you remember or sort of directions that were kind of developed in that period?

KH: Back then, actually, on neurology or different things, it was interesting because a neuroscience course was almost pure anatomy and physiology, nothing about systems or how they work or anything else. It was all very, very mechanical.

I remember a good friend of mine—he's still a friend—who is a psychiatrist, a fellow named Jim [Jamshid A.] Bakhtiar. He was actually an All-American football player for U-VA. He was Persian. We were sitting and studying together and he said, "You know, it's amazing. They teach you all this stuff, but they don't teach you how the brain really works, how the mind works back there. Wouldn't it be interesting to really know about this?" There was none of that. You talk about the absence of any kind… We had never had lectures on anything about neuropsychology or those other things.

In neurology, there was a wonderful guy, T.R. [Thomas R.] Johns [III], and he was the head of it, but his interest was really myasthenia gravis. He was at the neuromuscular level. There was another guy, whose name was Fred or Fritz [E.] Dreifuss, who was a very nice person, also.

One day—I think I wrote about this—when I was on neurology, I was on the way to see one of the myasthenia patients and this man stopped me. He said, "Doc, can you come over here?" I apologize for repeating this story. You've heard it.

HR: No, that's fine.

KH: I said, "Yes, what can I do for you?" He had this plate. Over there back at U-VA, they had like divider between the vegetables and meat. He said, "Look, all they serve here is vegetables. There's no meat. I don't understand. I want some meat." The meat was on his left side of the plate and the vegetables were on the right side. I said, "Okay." I just tipped the plate around like this. He said, "Oh, thanks, doc." [chuckles]

I had read about the hemianopia, people having blindness in one field. I went over to him. I just wanted to test to see if he was hemianopic. I put my hand up in his left visual field and said, "Do you see anything waving here?" He said, "Yes, there's your hand." I said, "Geez, so he's not hemianopic."

So I went over to Doctor Dreifuss and I said to Doctor Dreifuss, "I don't understand what's going on with this man." He said, "He has something that people call neglect." I said, "What's the mechanism?" He said, "I don't understand it. I'm only the second most famous neurologist from New Zealand. You've got to read this stuff from the first most famous neurologist from New Zealand." I said, "Who is that?" He said, "Doctor Derek [E.] Denny-Brown."

So I got his paper out named "Amorphosynthesis," and I read it, and it felt like I was back in Doctor Lutz's class.

[chuckles]

KH: I read this thing and I said, "I don't understand this at all." He wrote another paper called "Perceptual Rivalry." I read that, also, and didn't fully understand it.

So the next day I'm walking down the ward again and the guy calls me over and says, "Doc, can you come over here?" I said, "Yes, what is it, sir?" This time, he didn't have a plate in front of him. He said, "Can you get this guy out of my bed?" As a medical student, I'm trying to convince him, "See, this is attached to this and this." He says, "Oh, yes, that's very nice but, please, get this guy out of my bed. This is really a weird place." So he picks up his arm and throws it. It was his right arm. Of course, he's spastic and it comes back and hits him. He says, "Look! This thing is hitting me."

[laughter]

KH: I'm going, oh, my goodness…oh, my goodness. I said to him, "Look, that's your arm and the reason you can't move it is because you had a stroke." Then, he said, "I never had a stroke." I said, "Well, what are you doing here?" He said, "My family brought me here." So here's a man who had spatial neglect. He had not knowing his own part of the body, asomatognosia and he had anosagnosia, so he had all those things. What happened was that although I was a chemistry major at U-VA, back then, Jefferson made us take all these liberal arts courses, so I had a lot of philosophy courses. I was always very, very interested, like everybody else, in self-consciousness. I'm saying, "Here is a person who has a stroke, who is not conscious of half of his spatial world. He is not even conscious or aware that half of his body belongs to him." I said, "This has to be the most interesting thing that I've ever, ever seen."

That's what really brought me to neurology, because I was just *absolutely* amazed by this. When I started speaking to people what the mechanisms were, people said they really didn't have an idea about this, even with Denny-Brown. So that's what made me

really decide to go into neurology, just especially that one patient. But Dreifuss was really great. He said, "Try and read this and read this," and so forth. [chuckles] That was in medical school, very, very stimulating.

HR: Then, you chose to go back to New York for your internship. Do you want to make a few comments about that?

KH: Actually, my internship and PGY [post-graduate year] 1 and 2 were probably two of the happiest years of my life. I just absolutely loved it and that's back in the old days when we were…

HR: Every other night.

[laughter]

KH: Actually, a lot of it was every third night, but, still, when you were on, you were on.

Cornell originally started off with the main teaching hospital as Bellevue and, then, the New York Hospital moved and Cornell went up to New York Hospital. But back when I was there, New York Hospital didn't have any ambulance service. So we all wanted to be down at Bellevue because there was more excitement there. It was one of the most incredible experiences.

I came up a couple days before and they gave me my little white jacket, you know, and white pants with a little caduceus, red caduceus on the side. I walk in in the morning. They said to be there at seven o'clock and I walk in at seven o'clock to go to the Cornell division. Of course, back then, they didn't have pagers. They had these big loudspeakers and I hear, "*Hell*man! *Hell*man!"

[laughter]

KH: "EW Stat." I said, "What's EW?" "Oh, it's the emergency ward. They must have an admission." Sure enough. So I ran in there and here was this guy, probably late teens, early twenties they were wheeling in who was comatose. They bring him in and put him in a bed in the emergency ward, which is kind of both an emergency room and an intensive care unit all put together. He wasn't awake. I started my physical examination and listened to his heart. I notice that he wasn't breathing as well. What we had done when I was in medical school is when somebody died, we would go in there and practice putting laryngoscopes in and intubating them. So I asked the nurse, "Do you have an endotracheal laryngoscope and endotracheal tube?" She looked at the patient and looked at me and said, "Do you want me to bring some Nalline?" Back then, it was Nalline, Naloxone. I looked up in his eyes and he had pinpoint pupils. And I looked over here [referring to his femoral region] and all his veins had so many injections. I said, "Oh!"

[laughter]

KH: "Let's get an IV." She said, "What dose do you want?" I said, "The usual."

[laughter]

KH: She brought it over and, of course, I injected him and he woke up. He woke up right away. That was my introduction.

That year, I saw so many…so many sick people. It was just a wonderful experience, just the idea of knowing who is sick and who is well. I think it was the first time in my life that I really felt that I was doing something that was helping people. That was just such a wonderful, wonderful feeling. I really loved that.

Then, after that, I became hesitant about neurology because I enjoyed taking care of people and seeing them better. Back then, they would always say, "Neurology is interesting but there's nothing you can do for the patients." I'm saying, "Well, I enjoy doing that so much." Those two years were just absolutely wonderful. I think more than anything that really changed me into a physician, somebody who can handle sick people. It was just a wonderful time. It was also a time, because we had the students from Cornell coming through, that we did teaching. I loved doing that and, then, when I was a resident teaching the interns about that. I loved teaching and also realized how much I enjoyed teaching people, so it was probably one of the best years of my life. I really enjoyed that, loved it.

HR: Did you have mentors at that time? You guys operated very independently, in a certain way.

KH: The attendee would come in occasionally. In fact, in this book, I write the story about one of the attendees percussing the heart [Doctor Heilman makes the sound of loud patting].

[laughter]

KH: I might as well tell the story very briefly. He was a very, very arrogant attendee. He would percuss the heart like this and he'd listen to the heart. The resident—I think it was Walt Degnan, a year above me—put the x-rays on. He walks up and says, "You put this on *backward*!" The heart was on the wrong side. He pulls it down and flips it over. The resident goes back and pulls it down and turns it over and says, "This is the way it belongs." He had extra cardio insitus inversus. This guy then says, "Well, I realize his heart sounded [unclear]."

The other great thing about it was like Walt Degnan and these other people who were my residents, they did almost all the teaching. The same thing…so when I was a first-year resident, I did most of the teaching of the interns. Back then, that was all you did was two years of general medicine and the next two years, you would do specialty. So that was our general medicine.

HR: That story is funny because as a medical student, we did the same thing to a cardiologist at Mass [Massachusetts] General Hospital.

[laughter]

HR: I felt so bad. He was not very motive; he was very stiff. We had him listen to a patient's heart and we knew the patient had insitus inversus. He missed it, also.

[laughter]

KH: So that's – it's very tempting to do that as a student, I think. Mass General was always a little bit stiff.

KH: This guy, Dawson, he was just a very arrogant person and very dogmatic. He took the x-ray and said, "You've got it *backwards*! Turn it around." I think it was Walt Degnan. I'm not sure it was him. He takes it down and says, "No, sir, I think it goes like this way." That was just an absolute great experience.

HR: I'm sure your level of energy served you well there. Being on call every third night, some people don't do well with that.

KH: Again, the really sad thing—I wrote that in that little book [*PGY Post Graduate* Year *I: Lessons in Caring*] is that some people actually gave up because they realized they didn't have as much energy to be able to do it.

HR: It's more than just competence.

KH: Remember, I told you when I was a little boy sitting there listening to the subway…my wish has come true. Here I am up all night working with these people."[laughter] But, to me, it was such a blessing and such a privilege to be able to take care of them. As I said, you go to school all those years and years and you try and absorb and absorb and you're really not doing anything for anybody. And, all of a sudden, here you start your internship in a place like that. Guess what! It's up to you. It's really up to you whether people live or die. It really is based on your skills. The idea of being able to help people was just a blessing. Those two years, it was like, okay, you work and work and work and, finally, you see this flower blooming that allows you to really enjoy what you've worked for to be able to be successful and help people.

HR: We should mention that you wrote this book about those years because they were really indelibly imprinted on your memory. I was really impressed. This is your *PGY I: Lessons in Caring* book.[1] I think it's impressive how much you remember from that year of the specific people.

[1] Kenneth M. Heilman, MD, *Postgraduate Year One: Lessons in Caring* (New York: Oxford University Press, Inc., 2009).

KH: When I got off service sometimes, and even later on, I wrote down about the episodes and I put them in there. Then, this nurse who I spoke about had died and I always felt bad that I never wrote the story about that. My sister-in-law was a nurse with her. She said, "You ought to tell some of that story." I said, "I have all these stories." So I went back to my old files. The paper was turning yellow and they were written very, very rapidly. I went ahead and just redid them. The real true stuff, the positive names are real names. All the negative stuff, I changed.

[laughter]

HR: There were some we could figure out a little bit.

KH: Like the neurologist?

[laughter]

KH: We better stop there.

HR: I did interview with that person.

KH: Oh, you did. Okay.

HR: After that time, you were on reserve status in the Air Force. So it was during the Vietnam years that you were on reserve duty.

KH: Yes.

HR: You weren't sure what to do then because you had loved this experience so much.

KH: That's exactly right. The other thing is that you only did two years of general medicine and, then, you had to pick a specialty. As far as cardiology, I never could hear an opening snap.

[laughter]

KH: I still haven't heard an opening snap.

There was a guy, [Milton?] Luria, who I really liked who was doing a lot of great things with infectious diseases, but there was something about that…because it was too laboratory dependent and I wanted to be able to do things. So all the different specialties in medicine, none of them really grabbed a hold of me. I think I still loved neurology, but I couldn't decide.

The Vietnamese War was just starting up then. The military really got caught short. They didn't have enough physicians. I had a deferment for as many years as I needed to be fully trained. But I decided, okay, I'll give that up and go in the service now. So I had

to go down to Washington [D.C.] to sign on, to give up my reserve status. It was funny, because, as I said, they were short, and I signed, and the guy grabbed the paper, and he said, "That's great. We need an internist in Thule, Greenland." I said, "Thule, Greenland?" I reached across and I grabbed the paper back from him.

[laughter]

KH: He said, "Oh, you can't do that." I said, "Do what?"

[laughter]

KH: I said, "I'm not going to Thule, Greenland." The idea of me being in a Quonset hut for eight months, I'd be absolutely nuts. So he said, "Well, there's a NATO Hospital in [Ismir] Turkey. We need a chief of medicine there." I said, "I've only had two years of medicine." He said, "Look, let me tell you, we don't have anybody."

So they sent me over to Turkey and I was chief of medicine for what they call the NATO Hospital. It was maybe a little bit smaller than a 100-bed hospital and it took care of not just the American troops but all the other NATO troops, except for the Turks. We treated a lot of things. We treated a lot of strep throat and otitis media. I had a lot of opportunity to do things. I said, "You know, this is kind of boring. I think I'm going to do neurology." [chuckles]

Because I wanted to understand Denny-Brown's paper, I wrote a letter to Doctor Denny-Brown and said to him, "Can I come over as a…"

I should say two things. T.P [Thomas] Almy, who was the chief of medicine at Bellevue, wrote to me and said, "We want you to come back, blah, blah, blah." I wrote back and said, "No, I've decided that I want to *do* neurology." He wrote me back and said, "Okay, I'll tell Fred Plum you're coming." [laughter] I wrote him back and said, "No, I always wanted to train with Denny-Brown."

So I wrote Denny-Brown a letter and he said, "Can you come for an interview?" I said, "I'm here in Turkey." He said, "We'll call Doctor Almy and everybody else." Then, he just wrote me back and said, "You're a resident when you come back. You're accepted to our program." I said, 'That's great. Now I'm going to find out about…"

HR: What do you call it?

KH: Amorphosynthesis. I never found out yet—actually, I did a little bit.

HR: Just so we know, Doctor Almy was someone who was head of the residents?

KH: Yes, T.P. Almy. He was a wonderful man, I mean a really, really wonderful man.

When I looked at different internships, I wanted to go back to New York for family reasons. I remember, for example, somebody told me that Montefiore [Medical Center] had this wonderful neurology program.

I didn't have a car because I was on scholarship, so I borrowed a car from a good friend of mine, Bob Deutsch's, and I drove all the way from Charlottesville to New York, because they said, "I had it in the morning." I had to drive back then. They didn't have the super highways. It was like about a twelve-hour trip. I get there. I shave in the car and get dressed into nice clothes in the car. I go up and there were all these people, all the interns. Most of them are from New York and they give me a number. [laughter] I was sitting there. The University of Virginia is so much different, much different than that. Finally, they call me into this room at Montefiore and they say, "Blah, blah, blah. What are you interested in?" I said, "I'm interested in neurology." "Okay." A guy says to me, "Can you tell me what happens to the spinal fluid in TB meningitis?" I said, "Yes. In the cells, the sugar drops down and the protein goes up." He said, "Anything else?" He looked at me and I said, "Yes, the chloride drops." He said, "You are the first one to ever be able to answer that." He said, "We'd love to have you here." I still have this number right here.

[laughter]

KH: I said, "I appreciate that. But let me tell you something, to be honest with you, I didn't like the way you treated us and that concerns me. You're being crossed off." And I crossed them off the list. [chuckles]

HR: Did you interview with - ?

KH: With T.P. Almy, when I interviewed with him, he was the exact opposite. He asked me what I was interested in. He took me around. He showed me things. He talked about what was going on. He said that Howard Wolff died. Fred Plum hadn't come there, yet. The thing was all positive.

HR: Trying to help you.

KH: This is what we have to offer. What are you interested in rather than saying, "I'm going to test you out. Get on this line." Here they have all these years of medical school and college, they have all these grades, and so forth, and this guy is going to ask me about TB just as though I'm going to be an intern. [laughter] They may say that this helps us decide who's good and bad, but what they do is they turn off people like me who say, "Wait a minute. I drive all this way and you give me number. It's so impersonal. I come in here and you don't tell me about the hospital or ask me if I have any questions. You give me the questions. You test me." I'm saying, "That's not my ideal. If that's what the program is like, I don't want to be here." I told them that.

HR: You came back from Turkey and started with Denny-Brown. You'd never met him?

KH: Never met him.

HR: He was a big character.

KH: He was huge in American neurology.

HR: You know this history a little bit, but it was one of the first big neurology programs in the U.S. Before, they had mainly been in Europe.

KH: Yes.

HR: He had been sort of brought over from Europe. Do you want to say a few things maybe about that transition in neurology in the [United] States?

KH: It turns out it actually was never a big program. He only had two or three residents a year, but almost all of those went into academics.

HR: But it was prominent.

KH: Yes. Originally, historically—this is way before my time—Denny-Brown, Ray [Raymond D.] Adams, and [H.] Houston Merritt were all there at the same time. Supposedly, they didn't get along that well.

HR: Was Joe [Joseph M.] Foley around at that time?

KH: Joe Foley came a little bit later. Joe Foley worked with Denny-Brown very closely. They got along…the reason, Joe Foley's great sense of humor.

That was like the neurology program. The reason I chose it was because I was interested in neglect…amorphosynthesis. There were virtually no other programs that were really focused on what we talk now as behavioral neurology. But Denny-Brown had an interest in those things, so that's why I applied to his program.

It turns out he had a heart attack shortly before I came. He had promised us that he would be with us for two years. It was only a two-year program. The third year, you would take a fellowship, so that gave you all three years. Because he had promised us that he would be there, he did show up so we would make rounds about once a week or come in and discuss things in a Saturday conference. But there was another fellow, Simeon Locke, who was actually running most of the day-to-day program. So I never really got a chance to ask Denny-Brown a lot about amorphosynthesis. I read a lot before.

One of the things that got me interested—like I was telling you earlier—is this thing about motor neglect failure. I did present to him one time. There was a man who came in and he had this arm that was just hanging down, one of his hands like this just hanging down. I'm presenting him, and I said, "This man doesn't appear to use his left arm."

Doctor Denny-Brown said, "Well, Ken, is he hemiparetic?" I said, "Well, I don't know. He just has one of his arms that hangs down." There was really no description.

I think it was Rick [H. Richard] Tyler actually who told me, "If Denny-Brown had a dupintrens and they amputated his finger and he has kind of a naroma there, and when he gets irritated, he'll start rubbing his hands. When you see him rubbing his hands, that's right before he explodes.

[laughter]

KH: So he says to me, "*Heilman,* do you know what a hemiparesis is?" [acts out Denny-Brown rubbing his hand] I said, "Yes, sir." He said, "Is that man hemiparetic? Yes or no?" I said, "Yes, sir, I guess he is hemiparetic?" I always felt really bad about it. That was one of those things that, later on, he came back and brought that up.

What's interesting about Denny-Brown is when you read his papers, they're very, very difficult to understand. In fact, later on, somebody wrote a paper in *Brain* saying, "The way you did Denny-Brown was translate into English." But it turns out that in almost every domain of neurology, he made quantum leaps forward. I mean he was an absolute genius in *so* many different ways.

What was really neat was when he got up and he gave these rounds, he was very clear. Talk about a detailed person… If somebody came in, for example, and had an ulnar sensory loss, you just couldn't say you feel this and feel this. You had to use different [unclear] and actually make sensory maps of the different [unclear]. The same thing if somebody had a hemianopia. You used different sized objects on tangent screens. His notes were so detailed about all these things, tremendous descriptive neurology. He was very cautious—one of the reasons I never got to the amorphosynthesis—every cautious and very descriptive in his neurology, very cautious talking about mechanisms. He would talk about this localizes to this. This is the disease. But he wouldn't talk about this is part of this system doing this and that and so forth.

He was also very interesting. I remember there was one patient who came in who had a myelopathy. It was localized to the C5-C6 and the guy was spastic. I took him down and did a myelogram. Doctor Denny-Brown said, "Why did you do a myelogram?" I said, "I wanted to make certain it was there before…." He said, "No! You just tell the surgeons, 'This is where it is. You go there.'"

[chuckles]

KH: He was one of these people, you know, who said even if it didn't show, you have better evidence. He was not very, very strong on doing diagnostic tests. Really, the best diagnostic test was still the clinical aspects of it.

As I said, his conferences were really, really great. It was interesting, also, because when I was chief a resident there, Denny-Brown… I wasn't chief resident. I was in charge on

that Saturday for some reason. I can't remember. And Doctor Denny-Brown wasn't showing up. No, I was chief then, I think. There was a person who came in who had a one-and-a-half syndrome. I said, "Ray Adams spoke about this. He's here at Harvard. I'm going to call him." He came over and gave a talk. Afterwards—I won't tell you the names—all the attendings came over to me and said, "How could you invite that man here?"

HR: [laughter]

KH: So there was that tremendous antipathy, an animosity between the Denny-Brown and Ray Adams. I don't know what caused that. There were huge amounts of animosity. His talk was very, very, very brief, to say the least. He said, "I know you want me to say it's one-and-a-half syndrome. But we wrote this paper [perhaps, the title of the paper could be inserted here] [2]that shows you that, really, most people with brain strokes have multiple lesions, and he left.

[laughter]

HR: You know there is a difference between the people who give you a few sentences, this is what it is, and other people who want to discuss it.

KH: Yes. Denny-Brown was one of these people…

HR: He'd discuss it.

KH: Oh, he would discuss it tremendously, in tremendous length. Then, all these people like Tyler, and Dave [David M.] Dawson, Simeon Locke…

HR: Dave is very terse. That's my experience having worked with him. Dave Dawson is a wonderful…

KH: Oh, listen, he was one of our teachers. Actually, it was interesting because when he was there—we never presented to him—he would join in the conversation. You're right, but he'd usually make comments. It's mostly the other people, all the attendings who were there, that would just make comments about it.

HR: I had the opportunity to hear Ray Adams once discussing Tourette [syndrome]. He did go on at long length.

KH: Somebody said something had happened personally and he was a little bit down during that time; that's why he was very terse. That was the only time I ever met him.

HR: You did those two years. Were you as excited about medicine at that time?

[2] Insert citation

KH: Oh, I loved neurology and, then, Norm [Norman] Geschwind came, you know. I met Norm Geschwind before he actually took over. I had a patient… Do you want to hear about this?

HR: Yes, sure.

KH: This was about the same time when I invited Ray Adams that I also invited Geschwind. I'll tell you why. There wasn't any antipathy when I invited him. [chuckles] What happened is I had seen a patient down in the emergency room. His wife called him and he said to his wife on the phone, "You're mumbling and I can't understand you." She was in Filene's Basement. She used a different pay phone and he said, "You're still mumbling. I can't understand you." So then she came home. She knew something was wrong and kept on talking and he said, "Stop this. This is not funny." So she called all the kids and they all mumbled. They didn't know what to do, so they brought him into City Hospital.

It turns out I went to examine him and he couldn't understand anything I was saying, but his spontaneous speech was perfectly normal. Just out of frustration, I wrote him a message and he understood it. What happened when I examined him, he opened his mouth in talking, I heard a click pop, click pop. I looked at his chest and he had surgery. I said, "Did they put a valve in?" They said, "Oh, yes, he has one of these stainless steel ball valves." I said, "How much Coumadin is he taking?" They said, "Oh, he's not taking any Coumadin." I said, "We have to admit him."

What happened originally was, because they couldn't find anything, they had called a psychiatrist. He had no motor signs, nothing else. He was talking normally. It was that everybody was mumbling. He was actually getting a little bit paranoid about the mumbling. They called the psychiatrist and they were the ones that said, "Let's called neurology just to make sure it's not neurological." So when I heard that, I said, "Oh, no, he has to be admitted to neurology, because I suspect he had a stroke, because he's not on the Coumadin."

It was funny, because I admitted him and Simeon Locke gave me a really hard time about it. He said, "This guy is really crazy. He should be under psychiatry service." I said, "Doctor Locke, I don't know as much about neurology as you do, but I know some medicine," because I did this for four or five years.

[laughter]

KH: I said, "This man really needs to be on Coumadin. These valves are infamous for throwing emboli off." He said, "Okay. But after you've finished that…" I was convinced something was going on. There was no imaging back then and somebody told me about Norm Geschwind. So I invited Norm Geschwind over on Saturday.

HR: Wonderful.

KH: He examined him and he said, "This is a classical case of pure word deafness." He had this absolute case of pure word deafness.

HR: Those are not common.

KH: No, no! It was interesting because Simeon actually raised his hand and said, "Norm, if he couldn't hear, how come he recognized his wife's voice? How come he heard the telephone ring?" Norman said, "Simple. Simple. That's the right hemisphere that does that." His stroke was in his left hemisphere.

Now, we're starting to do the radioisotope scan. We discharged him, got him admitted to another hospital, got the radioisotope scan. They discharged him and sent him back to our hospital. He ended up [unclear] Heschl's gyrus.

HR: Then, that was like you were sold.

KH: Oh, yes.

[chuckles]

HR: [unclear] this man.

KH: Actually, I had planned to really go over for a fellowship with him, and then I heard that he was looking at the chairmanship, taking over when Denny [-Brown] officially retired. Just at the end of my residency, Norm Geschwind took over and I stayed at a fellowship year with him.

[break in the interview]

HR: You were speaking about first meeting Doctor Norm Geschwind, at that time, and he was going to come to Boston City Hospital, possibly, and you wanted to work with him. Do you want to tell us a little about that transition and starting to work with him?

One thing I thought was interesting is that it didn't sound like a lot of people knew much about what we called behavioral neurology despite the fact that in Europe, it had been very big for a long time. I don't know if in retrospect that we look back at the Europeans, we look at the people who were doing that sort of thing, that's probably part of it. If you look at the journal articles, there were huge amounts of publications [unclear]. I guess that's the story of what Norm Geschwind did. It's interesting that you mention Simeon Locke. You mention the New Zealand folks back in medical school. Whoever had said he didn't think you needed to admit that patient was not aware of these other things. What was that landscape like here?

KH: In general in America, there were virtually very few behavioral neurologists. They weren't there. Historically, the way it really started in this country was probably more through Edith [Freund] Kaplan. Edith had this patient that she saw. Her dissertation had

been on learning skills in children. She saw this patient who, when they asked him to perform commands with his left hand, couldn't do them, but could do them with his right hand, to verbal commands. Norm Geschwind was working with her and Norm Geschwind saw the patient. Up to that time, Norman wasn't into behavioral neurology. He had been writing about calcium and myotonia and a lot of other things. It turns out that this patient had a calossal lesion.

What's interesting—this is even before [Michael S.] Gazzanega and [Roger W.] Sperry, and so forth - that paper was published, I think, in about 1962.[3] Then, Norman, because he was fluent in reading German and French, he went back to look at the literature. He said, "Oh, my goodness, look at this."

HR: Huge.

KH: "Look at this huge literature." Most Americans…we don't teach this in the medical schools. If you go back in the textbooks of neurology, there's very little about any of this stuff. He was really amazed. As he started going through this, he got very, very interested and realized, just as [Joseph Jules] Dejerine had said… Dejerine actually came up with a lot of concepts about disconnection. He [referring to Norman Geschwind] wrote that classic paper in *Brain* in 1965 about disconnection syndromes.[4] That paper, as I said, came out only two years before I started my residency in neurology and most people really didn't know it. Now, after that paper, Norman stayed at the Boston BU [Boston University] and VA [Boston Veterans Administration] – he was chairman over there. And they did start training some people.

The first one was actually [D.] Frank Benson. When Frank Benson was in practice out west—I'm not sure whether it was Oregon or Washington—he read that and he was in practice and said, "This is what I always wanted to do. He closed his practice. He took all his family all the way to Boston and took a fellowship with Norman. Then, other people came like Andy Kertez, and Al [Alan B.] Rubens, and so forth, not many, because it was just a couple years. Then, of course, when he came over to Harvard, then it was more and more people that started, people like me.

When I took my fellowship, I went back and, again, coming back to Denny-Brown about the concept of amorphosynthesis. One of the things I got about this paper is about the concept that in order to have a concept of space, there has to be a synthesis of multisensory input, that includes visual, and auditory, and some kinesthetic input.

What happened was that one of the people that Norman brought to the Harvard Neurologic Unit was a person called Deepak Pandya. Dee was—or is still—one of the most wonderful people in the world, a brilliant guy, very sensitive. Actually, he made his living from being an internist at one of the other VA hospitals. He would do this

[3] Gazzaniga, M. S., Bogen, J. E. and Sperry, R. W. (1962) Some functional effects of sectioning the cerebral commissures in man. Proc. Natl. Acad. Sci. 48, Part 2, 1765-1769.
[4] Geschwind, N. Disconnection syndromes in animals and man, Parts I and II. *Brain* 1965; 88: 237–294 and 585–644.

anatomy stuff almost as a side project, as a hobby. He wrote this paper, several papers, with [Henricus Gerardus Jacobus Maria "Hans"] Kuypers and other people showing that it's already been known that each one of the primary sensory cortices project to its specific association cortices.[5] What he showed was that all these sensory associating areas actually projected to the monkey's banks of the superior temporal sulcus and the monkey's inferior parietal lobe.

So based on Denny-Brown's concept of amorphosynthesis, I wondered if we ablated that area in monkeys whether or not we would show neglect. So I worked with Deepak Pandya as part of my fellowship and actually ablated that area. Then, we started all the monkey stuff trying to understand this network. Pretty much, that's important for attention. That was during my fellowship with Dee. Dee was just one of the most wonderful mentors about the anatomy and understanding and how anatomy, in some ways, is the basis of what anatomic connectivity is the basis of function of these functional networks. That was something also that Norman believed in. That was what the disconnection paper was about. That was a very important concept that helped develop my understanding of this [unclear].

HR: At that time, the model of monkey ablation experiments was really the thing that people did.

KH: Yes.

HR: They were doing that in the 1950s trying to show the memory system was working that way, but they continued that into the 1960s.

KH: Yes.

HR: It was a big era where people looked at monkeys. That's sort of not done as much anymore. Maybe because we have more tools…

HR: We have functional imaging now. But functional imaging still doesn't tell you the same thing that the ablation paradigm teaches you. I think the ideal would be to put them both together, because there are weaknesses of the ablation paradigm, also.

But doing that is where we came up with this whole network concept about attention. We also made ablations here with Bob Watson of the cingulate gyrus and other areas, because Dee showed that the cingulate projects both to this area in the temporal parietal region and to the area in the frontal region in which you also produce neglect. So what our hypothesis was is this all part of a network? So we did that, but that also came up before because of that paper that Ed [Edward Valenstein] and I wrote about the front lobes.[6]

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[5] Pandya DN, Kuypers HG. Cortico-cortical connections in the rhesus monkey. Brain Res. 1969 Mar; 13(1):13-36.

[6] Heilman, K.M., Valenstein, E. Frontal lobe neglect in man. Neurology, 22:660-664, 1972.

HR: What was the date of that paper? That was on the attentional network that you wrote with…

KH: I think it was about 1972.

HR: With Bob and yourself.

KH: That was later. The original one was on humans that we wrote.

In fact, it was interesting, because the *Journal of Neurology* cited two of the most important papers in behavior neurology…

I have to mention Ed Valenstein. Ed just passed away, [March 8, 2013] unfortunately. Ed was a resident one year behind me and worked very, very closely with me.

What happened was the way I got kind of into this was—that I was supposed to be on a fellowship doing research primarily—whenever Norman was short of some clinical person, he'd say, "Ken, could you come as a consult service?" [chuckles] Of course, I would do it, because I always loved that.

I saw a patient on what they call up there Peabody [Doctor Heilman pronounces it Pea-buh-dee, accent on Pea] for what the rest of us call Peabody [Doctor Heilman pronounces it Pea-bod-ee, accent on bod].

[chuckles]

KH: It was the Harvard medicine service. The patient had neglect. I diagnosed it as neglect and said, "This is a stroke of the parietal lobe." Then we had the radioisotope imaging and the way that worked, of course, is there was a breakdown of the blood-brain barrier and the isotope would leak out and that way you got the picture. The resident said to me, "Shall we get a radioisotope imaging?" Being trained, in part, by Denny-Brown, said, "I just told you where the lesion is. Why would you want to get that?"

[laughter]

KH: Sure enough, about two days later, he's walking with this folder of x-rays under his arm and had this big grin on his face. He says, "Ken, do you remember that patient who you said definitely had a parietal lobe stroke?" I said, "Yes." He set up the imaging and, sure enough, there's this discreet lesion in the frontal lobes and, sure enough, when I started looking, we discovered several more. Then, I started seeing several patients who had mesial lesions of the front lobe, including the cingulate gyrus.

Based on that, Ed and I gathered these patients and we wrote that paper saying that there's a frontal cingulate temporal parietal network that's important for the allocation of attention. Ed was such a humble person. When we wrote this, I said, "I think this is

really a nice paper. This is really talking about attentional network, which nobody ever spoke about before." Ed said, "Awww, you know, who cares? It's trivial stuff. This stuff is really trivial." That's typical Ed.

What happened is, later on, the [Journal of] *Neurology*—I can't remember what year, about 1999 or maybe 2000—wrote an historic thing about the two papers in the most recent times that were the most important and they talked about Norman's colossal thing, because that was the first modern colossal disconnextion before Sperry and Gazzanega and they talked about our paper. So I showed it to Ed and Ed said, "Ohhh, that's because you have all theses friends on the editorial board."

[laughter]

KH: What we did in monkeys, we didn't know exactly where it was that we made this lesion. It was the cingulate gyrus. What's interesting now in the functional imaging things, if you look at the functional imaging, the cingulate gyrus always lights up. So talk about like its being important to this and important to that, they don't realize all those people…

HR: are attendings -

[chuckles]

KH: Right, either that or it's the seed of the soul. In the Cartesian sense, not the pineal. It's just up a little bit.

We really showed, because that is the connection between the neocortex and the limbic system, part of attention is allocating those resources to something that's really important.

HR: Your point there is, also, about how knowing the lesion literature informs interpretation of the functional studies and how important that is.

KH: That's right. That's exactly right.

HR: That's something that not everyone pays as much attention to. It's nice when people do.

KH: Yes.

HR: Sometimes, when findings are kind of contradictory, I think we need to explain the differences. I know we've been to lectures together where there's been some finding about prosopoagnosia and somewhere in the left parietal area, or something, and you're like, well, wait a minute. Left parietal [unclear]? That doesn't quite fit. We need to think about it a little bit differently.

KH: I think in the functional imaging, there are so many studies coming out. They'll do some task and, then, they'll look at all the areas that light up and they'll say, "This is the distributed network that causes this." The point is it can't control for all the things that they're doing. That's the first thing. The second thing is you can't discriminate about what systems are excitatory and which are inhibitory. The third thing is the better you get to do something, sometimes, the less it lights.

HR: Good.

KH: What happens, in some, not all, there's a big chunk of functional imaging that's almost like phrenology, so much phrenology. Now if they combine *with* the ablation thing, then I think together that would be so important. Some people do it, but a lot of people don't go back and look at the ablation literature who are doing the functional imaging. I think it's really a shame.

HR: Yes. They do show different things. When you take a piece out, it may do something different than how the brain is working as a system as a whole.

KH: Yes, that's right.

HR: Obviously, this is a critical piece if it distorts it.

Going back to that time just a little bit when you did your fellowship… I didn't really realize that you worked with Deepak mostly in this research. It was really important to know about the patient exposure you had with Ed Valenstein then and collecting patients in the context of this research.

KH: Ed, when I left—Ed was behind me a year—he actually took over the monkey research and continued doing it. Then, when I came down here, Bob Watson had read some of the monkey research. He wanted to continue.

I became phobic of monkeys. What happened was right after my son was born, I was talking to somebody, and one of the Rhesus monkeys I had taken care of bit me. I don't know if you can see that puncture hole right there, but that's right where it was. The monkey actually had lesions around this thing. So, I thought, oh, my gosh, he has the herpes virus which, in humans, is deadly. It kills you. So I'm counting off the days.

HR: Ohhh.

HF: I guess he didn't have it. Either that or I have a good immune system. After that, I said, "No more monkeys."

I came down here and Bob Watson said, "This is the most fascinating thing." There was nothing like that around here. He says, "I'm going to get monkeys." As a resident, he actually got the monkeys. We got a lab and we started. Then, Ed went up to Dartmouth

and we had an opening here, so I recruited him here. Then, we got funded and we did have monkey research funds for about twenty years here looking at that stuff.

HR: Maybe you could make a few more comments about Norm Geschwind, just because of his role in behavioral neurology.

KH: Sure.

HR: And he was such a character as a man. I think you knew him both from the perspective of his research, his approach to thinking, and as a person. Maybe you could make a few comments about how you saw him influencing other people, what kind of legacy he left in the context of the structure of how he directed that unit, and how he influenced you, too.

KH: Oh, yes. As were talking about in America, behavioral neurology just wasn't part of neurology programs. In fact, even when I got recruited here, I hadn't put all those papers that would impress and so forth, so only papers when Mel [Melvin Greer] hired me was my ones on infectious disease, my own personal…tuberculosis, from the mouth to mouth, and some other things like that. He said to me, "Now that you're coming, I understand you're doing a lot of research up there." I said, "Yes." He said, "What kind of equipment do you need?" I said, "Pencil and paper."

[laughter]

KH: He said to me, "Pencil and paper? What kind of research are you doing?" Back then, it was called higher cortical function rather than behavioral neurology.

HR: Okay.

KH: A lot of people called it higher cortical functions, but it turns out a lot of them are not cortical anyway. [chuckles] I said, "I'll be doing higher cortical function," what we call behavioral neurology today. There was this huge silence. It was probably only one second, but, to me, it seemed like forever. He said, "Well, Ken, I guess what you do on your own time is your own business."

[laughter]

KH: Now, I say that, but let me tell you, he was unbelievably supportive in *every* way, in every way possible.

I had a lot of job offers. Norman wanted me to stay up there. He offered me an assistant professorship. I actually remember writing to Bob [Robert A.] Fishman out in [University of California] San Francisco [UC-SF]. I have the letter someplace. He wrote back to me and said—I'm not quoting this exactly—"Who would ever hire a behavioral neurologist?" [laughter] That was kind of the zeitgeist around the whole country.

HR: I went to my residency interviewing for neurology at UC-SF. I interviewed with two people there who said, "You're interested in behavioral neurology. We don't have anybody here in behavioral neurology and we don't plan to get anybody here in behavioral neurology. Why are you here?"

[chuckles]

HR: That was the early 1990s, I guess.

KH: Now, you look and [Stanley B.] Prusiner.

HR: Right, he's done a wonderful job there. But there was a real lack of interest that persisted for a long time.

[brief discussion about video]

KH: Even Prusiner said that when he started doing his research, he was very discouraged by Fishman and other faculty. It was really interesting. That wasn't only them. That was around the whole country.

Now, people realize, especially with the aging population, that cognition is not trivial. This is not trivial stuff you're talking about, but really deep, fundamental type things. I think it's because like here, a lot of the neurology departments weren't independent. They were actually, in most places, in departments of medicine, so they had this internal medicine kind of approach to things; whereas, studying behavior is more like psychiatry. That's too soft.

HR: I think somehow we ended up skipping over a little bit about Norm Geschwind. So let's go back to him, again, briefly. I know he was kind of a raconteur, liked to talk. I don't know; that's what I heard.

KH: He was very verbose.

[laughter]

HR: He was enthusiastic.

KH: Very enthusiastic about his ideas.

HR: That was something that inspired people, I guess. He wrote quite a bit. He was able to write.

KH: He was a beautiful writer.

One thing that was so very important and something I tried to learn later on. Two things. When he gave a lecture – you can give a lecture for lots of reasons. A lot of people think

that the only reason you should give a lecture is for didactic purposes, what people want to learn. But his lectures always invited curiosity. He let people know there are a lot of things we don't understand. So when you left a lecture, you started thinking about things, not just saying, "What did I learn? What [unclear dolomic?] did I learn about that?" When you heard something interesting, he would never pooh-pooh it. He was always, "Tell me more. Let's understand it." So another important thing is that he invited curiosity and excitation. When I started writing those papers up there, he was very, very excited.

The other thing that I learned from him—this was part of my thing growing up in Brooklyn, also—is about protecting people. Denny-Brown and Ray Adams and these other people had at Boston Neurological Society. That's still there. I did this paper on head trauma and the type of aphasia associated head trauma.[7] It wasn't published yet. Anomia was the most common type of aphasia that we saw with it. I didn't know a lot about fluency. I'll bet you now probably there is also a lot of decreased frontal fluency, but it was anomia. What happened was, at the end of my lecture, somebody got up—I don't remember who it was—and said, "Heilman, do you know what side of the head they were hit on?" I said, "No, I didn't record that. I'm sorry." He said, "How could you leave that out? That was *critical*," and going on. Norm gets up and said, "That's an irrelevant question. Sit down. Does anybody else have questions?"

[laughter]

KH: I really appreciated that. I was a resident at that time, or a fellow, actually, and here's somebody telling me all my research is a piece of crap. And no one has ever done anything… Back then there was nothing on head trauma and cognition. It was one of the first things. Here's a guy attacking me for not knowing which way the rotation forces were and so forth. And Norman said, "Sit down."

[laughter]

KH: The other important thing was this idea that he did protect us. He was truly a mentor. Even later on when I was down here, he would call me, and we would talk about interesting things, and he would let me know about some of the things he was thinking about. In fact, it was interesting—here's one example—he called me once and he said, "Ken, have you ever had any interest in astrology?" I said, "You mean astronomy." He said, "No, I didn't make a paraphasic error. Astrology." I said, "No. Why do you ask?" He said, "You're living in Gainesville. There are a lot of cattle around there." I said, "Yes." He said, "Did you ever notice that calves were born in the spring?"

[laughter]

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[7] Heilman, K.M., Safran, A., Geschwind, N. Closed head trauma and aphasia. Journal of Neurology, Neurosurgery, and Psychiatry, 34:265-269, 1971.

KH: I said. "That did happen." He said, "Did you ever think why?" I said, "No, I haven't given it a lot of thought." He says, "Well, it turns out it has to do with hormones." I said, "What do you mean?" He said, "Hormones in animals vary with the season. So there are certain times that people think animals are more fertile than other animals and other things"…going on and on. He says, "Therefore, as the hormones change with a season, if somebody is in utero and there are seasonal changes in the hormone, can that affect their growth and their personality?" I said, "Theoretically, you may be right, but don't tell me about it."

[laughter]

HR: There's a lot of research on that.

KH: On it, now. Yes, there is. He was actually the first. I'd have to go back, I don't know if he ever wrote anything about it.

HR: But every open-minded in his thinking.

KH: Yes, yes. It was really neat because, in some sense, here he takes something that most scientists would say, "This is the greatest hogwash." He would say, "Now, look, if this has been around for so long and people are thinking about it"—he would introduce things like that—"could there be some basis of that?" Most of the time, guess what, when you start investigating things like that, there is a basis. Now, the problem is it became a pseudoscience and had people claiming all these things. But even if you go back to [Franz Joseph] Gall, Gall's major postulate is that there's modularity and that better developed modules work better. Those were his two major hypotheses. It became a pseudoscience. Even his idea about the skull is true, but it became a pseudoscience because people made all these claims that were not true.

HR: Yes, for sure. So he [referring to Norman Geschwind] was also creative in a certain way in terms of trying to integrate different ideas about different things.

KH: Yes.

HR: People are creative in different ways.

KH: He was more of a synthesizer. He would look at all of these things and put them together.

HR: Not as much an experimental person…

KH: He was not I'm going to go out there and test this hypothesis and so forth. That's how we differed a lot, because I would go out and say, "Let me go out and take a look at this." He liked to read and synthesize based on what he had read. As I worked with Dee, he gave me the other side. Dee was an empirical person. So that combination was just really perfect.

HR: Since we're talking about Boston, I saw that there was a publication and the title intrigued me, by Martha [Bridge] Denckla, I think. You participated in this book. The title was *The Boston Process Approach to Neuropsychology,* [correctly *The Boston Process Approach to Neurolopsychological Assessment: a Practitioner's Guide]*.[8]

KH: Oh, Neuropsychology? I thought you were talking about Dave Dawson's book about the Harvard Neurological Unit.[9]

HR: No, it wasn't that. There was another book.

KH: Oh, I know the one. That's actually about Edith [Kaplan]. I wrote a thing about the corpus callosum in that.

HR: So it's about Edith and her approach, maybe.

KH: Right.

HR: One of the things that you said sort of stimulated Norm in the beginning was this collaboration with Edith. Then, behavioral neurology sort of continued there in Boston. It always had this collaboration with the neuropsychologists. Deepak was another person…this kind of model where you have the neuropsychologists and the neurologists working together.

KH: That's very important.

HR: That's a school, in a way. I sort of think about it that way, maybe, and I think people who trained in different places have different experiences in terms of the approach to…

KH: I think that's very important.

HR: Do you want to comment on that?

KH: I think that's very important. The way I got to know those people… When Norman came over, he didn't like to drive, so he would say, "Ken, com on. Drive me over to the VA Hospitals," so every Thursday. He hated the way I drove. I had this little Austin-Healey and I was a pretty aggressive driver. The whole time, he would be white.

[laughter]

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[8] Lee Ashendorf, Rod Swenson, and David Libon, eds. *The Boston Process Approach to Neurolopsychological Assessment: a Practitioner's Guide* (New York: Oxford University Press, 2013).
[9] David M. Dawson and Thomas B. Sabin, *The Cradle of American Neurology: The Harvard Neurological Unit at the Boston City Hospital* (Hollis, New Hampshire: Hollis Publishing, Inc., 2011).

KH: We went there and, of course, we met all those people, Edith, and Frank Benson, and Hal [Harold] Goodglass.

The other thing that Norman really, really appreciated, rather than saying, "This is a little club of neurologists," is the idea that people from different domains have things to contribute. I think that was really important. I don't know if he ever explicitly said this, but, in my book on creativity that I wrote,[10] if you look at any society that became very, very creative, in order to have a creative thing, you have to be able to look at things in different ways and, then, make a synthesis of those ways. Norman actually was the one who did that. So that's right. Edith actually had trained as a developmental neuropsychologist. So we had Edith. She was very interested in skilled movements and stuff like that. Hal Goodglass, who was almost really much of a linguist, was very, very much interested in language. He had Nelson Butters there who was doing all that work on memory stuff. He was, I would almost say like a physiological psychologist from a neuropsychological perspective. He had Frank Benson who really came with the traditional neurological kind of material. And other people. They were all there. Then, he realized how important it is to bring up people and he started the first, really, post-doctoral training program in neuropsychology. So another important idea about Geschwind is his idea of including a big domain of individuals from different fields and having them look at different ways.

On these Thursdays, they would present the patient and, then, each week, they would have a different discussant. So one week, it would be like Harold Goodglass and, then, Edith or somebody else. They would present it from their domain and the other people would join in from their domain.

HR: When I was at the VA Hospital in ??, they still have the Thursday case rounds.

KH: Oh, do they really?

HR: Yes, and have people discuss. That's one of the highlights.

KH: That's great.

HR: I think that's interesting, also, the case approach, which, maybe, is something that was part of that.

KH: To Norman, it was very important. In some way, it kind of scares me what's going on in neurology now, because it's been so anti-case. I remember Hauser. I guess he may be retiring from *Annals* now.

HR: Which Hauser is this?

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[10] K.M. Heilman, *Creativity and the Brain* (New York: Psychology Press; Division of Taylor and Frances Books, 2005).

KH: This is the guy from San Francisco, the chair.

HR: Oh, yes. Steve [Stephen L.] Hauser, not Mark [J.] Hauser.

KH: He was the editor of *Annals of Neurology*. He wrote an editorial and said that they're going to publish virtually no more case reports. I was going to write a letter to him about it, because, still today, the case report is really the fundamental whisper of nature that allows people who are doing research to change that from a whisper into a shout. If you think about any new disease that was ever described, it was case reports. He actually put a limit. He said, "Oh the series has to be"—I'm making this up; I don't remember the exact number—"over a year," or whatever it is.

I was thinking, okay, let me see, I'm a neuro-oncologist and I have five people with glioblastoma multiforme. I give them this medicine and I cure them all. I send it in to *Annals of Neurology* and it gets rejected because it's nothing more than a case report.

As we talked about earlier, somebody told me, "If anybody remembers me a year after I die, it's not going to be for behavioral neurology; it will be for the orthostatic treatment." These are people, as you know, who stand up and shake. It turns out that would have never been published because it was three cases. [chuckles]

HR: You've written on this topic of case reports very nicely. It's very near and dear to my heart. I did a course at the AAN on that topic, as well. I think people get confused a little bit when you hear of evidence-based medicine, that it's all about treatment and to have evidence for treatment. You make an example of the case where if it's all or nothing, you can make a case that you don't need a thousand patients. Anyway, there's a lot of confusion about that. Cases often show you something new, as you mention.

KH: That's right.

HR: It's changing the way people think about things. You can have one case that contradicts a paradigm in a certain way and really have an important contribution.

I want to just mention, since I was working in sleep researchers some, they have a society meeting. They have one restriction on abstracts and they accept every abstract. The exception is they will not take any case study.

KH: Yes, it's really unbelievable.

HR: It's hard to judge on the basis of an abstract, but, still again, there's an incredibly deep bias. Actually, in professional meetings when they're evaluating faculty, they say, "Well, one thing we'll do is we'll count papers at a certain level, but if it's a case report, we're not going to count it." Here is a case report where he spent two years developing a theory about…

KH: Here's my problem with that. This is kind of philosophical so I don't know if you want to hear about it.

HR: It's good…good.

KH: The bean counters have taken over the world. In fact, I think—he didn't say it this way—in Hauser's thing, he said that the least-quoted articles are the case reports. So in their journals, how do you sell more journals is your citation. The citation index is based on how many people quote the papers from there. So what you do is if you go ahead and go to the case reports, that increases the citation index. So all you're doing is satisfying the bean counters, basically. Now, it's the same thing in academic medicine. They pay people on RVUs [relative value units]. Does anybody look at the standard of care, how many brilliant diagnoses you make, how many people you help out, how empathetic you are, how much you care. All these things that you and I know, do you think the bean counters…? It's the same thing, the exact same thing that's happening in the journals. So the journals know, if you want to increase your citation index and you open up any journal, if there's a high citation index, the first thing they'll tell you is about how high it is. If you want to make it higher, then you write these big series, like Ron [Ronald C.] Petersen's thing.[11] Petersen is a wonderful person. The thing is this ends up in the *New England Journal of Medicine*, so they have, I don't know, hundreds and hundreds of people with mild cognitive impairment. They give them donepezil and they find out that some people got a little bit better.

[laughter]

KH: If you had a case report of some medicine where you gave X medicine and it cured the person of Alzheimer's and you sent it to the *New England Journal of Medicine*, what's your chance of it being published? It would be zero.

HR: Yeah, and that would be a cure. It's interesting. That's a big area.

Getting back to sort of where we came from in the Boston approach… There's been increased recognition in behavioral neurology and the importance of it because of the recognition of aging dementia. But, at the same time, there are people in that field who come from a different approach to cognition. So I think coming from the Boston school, or maybe we wouldn't define it that way, there is more approach on how do we understand the brain and case studies or series can have a very important role, whereas, if there are other approaches just saying, "Look, we have this kind of dementia. We want to have one hundred patients with this kind of dementia and find out what this disease is like in a certain way." You'd hope that each could learn from the other. I think the mold of having more patients is more dominant. Do you think there is something about…?

[break in the interview]

[11] Ronald C. Petersen, "Mild Cognitive Impairment." N Engl J Med 2011; 364:2227-2234.

HR: …back to how it's different in its approach, to asking questions, and its methodology. I was intrigued by the title of that book about Edith Kaplan or process school of neurology or something.

KH: Norman used to talk about two or three schools of research. Going back to Ron Petersen and so forth, he talked about the Mayo Clinic approach and what he called the Harvard approach. The Mayo Clinic approach was you look at Olmsted County [Minnesota] for fifty years, how many people had this disease, how long did they live, blah, blah, and so forth; whereas, the Harvard approach was seeing something that was nature or coming up with an a-priori hypothesis and, then, going out and testing that a-priori hypothesis. He said it's a much different thing. Don't misunderstand me. I think both of those are important.

I think however again, because of the bean counters, the bean counters like a huge number of people rather than somebody who comes up with a very creative idea even based on one observation of one, if it's a creative idea. The idea for journals, I think there should be at least two-fold and many manifold, but two-fold. Yes, they're supposed to provide information and that's what the bean counters like, but they should also have the job of excitation, of generating new hypotheses.

HR: Stimulating new hypotheses.

KH: That's exactly right, and saying, "Here's something new that we need to go out and really examine." Now, how many of those are going to be quoted? They're not going to be quoted as much, because it's not giving you pragmatic data, but, it turns out as far as actually changing our field and really being able to initiate new methods of investigation with new ideas, that is unbelievably important.

But the bean counter, just like patient care is to us, all those things are important. How many RVUs? You can quick RVUs if you treat everybody like a machine. Got this, blah, blah, blah, next patient, but what about the other part? What do the bean counters care about the RVUs? Nobody looks at quality of care.

HR: They just look and see if they've got their flu shot.

KH: That's right.

[chuckles]

KH: I think those are very, very important – very, very important – issues.

HR: I think a lot of people recognize that, at least with regard to the RVU part of things.

I may be biased but when I read all older papers, I often feel like there's opportunity to discuss the ideas. You see these monographs by [Tom] Lissauer, or something, talking about visual agnosia and it's just rich with very careful thought, thinking about his

evidence, an ability to kind of take it one step beyond and say, "Well, maybe people hallucinate because they have top down processing that fills in" and come up with some really interesting thoughts.

KH: I think that's so important.

HR: I think in *Brain*, the journal, my feeling was that you had that opportunity.

KH: And it's changed.

HR: It's changed some.

KH: They wouldn't publish Geschwind's paper now.

HR: Yes, they wouldn't. I think in a lot of journals—my tendency is to be verbose when I write—you have to do this short and sweet, to the point, here are the facts, here's the conclusion. I think it's so interesting you bring this up. The sort of discussion that stimulates – it could be this or it could be that – maybe isn't appreciated. It contributes to length, which maybe is not a priority…so that sort of stimulating curiosity, inviting new ideas.

KH: Norman was tremendous. His whole thing, like in that 1962 paper, that was a case report. He thought that important cases like that can really teach us a tremendous amount.

HR: Someone recently was telling me about how when you write a paper, you have to keep people's attention. They have a very short attention span. So if you talk too much… [chuckles]

This is the point where I have written down things about how did this time in Boston affect your next step in terms of approach to studying as an investigator in the field of high critical function, behavioral neurology, starting with the patient. We talked a little about that. The lesion method was sort of the most common at that time.

KH: That's right.

HR: There was this information processing model that Deepak and, also, Geschwind and, also the sort of inherited view from the Europeans. In *Matter of Mind.* which is a really wonderful book…[12]

KH: Thank you.

HR: I think the way you think about brain behavior and when you encounter a patient what kind of questions that invites and, then, how to test those questions really provides a

[12] K.M. Heilman, *The Matter of Mind: A Neurologist's View of Brain Behavior Relationships* (New York: Oxford University Press, 2002).

window into some of the creative thought that you have and, then, your experimental approach to measure. It's not just having ideas; it's also testing those ideas. That approach that you describe there, this information processing, the lesion method, do you want to make a few comments about how you think that's still important? Is that the way you think behavioral neurology should continue? I mean, there are a lot of tools and a lot of methods. Is this something that's seen its time? Things get reinvented so you have information processing reinvented as network…and it gets a new name, but in some ways, it's the same thing. I'd be interested in your comments about the value of some of these approaches that might persist today.

We've spoken a little bit about seeing a patient and seeing a whisper of nature. You see something new. First of all, you have to be observant. You have to have time to look at that patient. You have to actually know what's important about that patient. In order to know what's important, you have to know kind of what we know about that. If you don't even have a sense of that field or what's new, you don't see what the patient could be showing you. I'm speaking out of my own perspective. At least in our program, sort of the residents, don't necessarily get trained on basic behavioral neurology, so they wouldn't even know where to start. They wouldn't necessarily even see what was there. So first to be able to see what's there is the first part of things. We have the scans. We can find out what people have. Everybody is interested in how many hours has gone by, and what their blood counts are, and making sure they get the right treatments, but in this busy medical system that's very technologically advanced, we still have the patient and the patient's experience in front of us and the brain, which we don't know everything about. [chuckles] Is there something we're missing? Is there something that we need to not turn away from? I'm kind of stating my opinion, but thinking back to the competing goals of different research groups and missions, studying the 50,000 people or couple of thousand people versus looking at the patient, where do you see this kind of approach going in the future?

[construction noise outside]

KH: Let me come back and talk about the organization of neurology, because I think you're asking kind of a deep question. I think a lot of people are not entirely aware of this, but when we describe neurology, it's almost like a three-layer cake.

Let's say the first layer is pretty clear to people, so we talk, now, about pediatric neurology, and adult neurology, and, even now, geriatric neurology. That's a cake based on age.

Then, there's a second cake [layer], which a lot of people know about, which is disease cake so we have experts in multiple sclerosis—these are all fellowships that you get—and experts in stroke, and on and on and on.

Then, on top, you really have almost—it should be that the pie is reversed this way—basic science domains. What do I mean by basic science domains? You have things like physiology, so EEG, [Electroencephalography], evoked potentials [EP], even PET

[positron emission tomography] scanning, and fMRI [functional magnetic resonance imaging] would be that, in a way. Then, you have, let's say anatomy, which is another one and you can go on and on like that. One of them really has to do, as we would talk about it, with networking systems. Behavioral neurology is a basic science in the sense of it's looking at networks and systems. It turns out that it doesn't make a difference what disease you look at. At one time people would say, "Oh, ALS [Amyotrophic lateral sclerosis]**,** that's just purely a motor neuron disease. It just happens in the spinal cord. Guess what.

[chuckles]

KH: Not correct. So anything that affects anything almost in the body…so even if you have failure of your autonomic nervous system that we talked about earlier, does that have a decreased feedback and really change your emotional reactivity?

So we talk about systems when we talk about how a disease affects the system and how the system affects behavior. The critical outcome of humans is our behavior. [chuckles]

HR: That's what matters in the end, isn't it?

KH: That's it; the final common pathway is behavior. So we're talking about different systems and we're talking about network systems. I think a lot of people don't really appreciate that behavioral neurology. It's easier, really, to say, "Oh, I'm just an expert in this disease." Like I talked about earlier, why didn't I go into ophthalmology and suck out cataracts? That's one disease; I can cure them. It's very focused. There's that disease. So what did I do? I went 180 degrees where we talk about these complex networking systems that have huge amounts of interaction. That's what behavioral neurologists really look at. This is really a whole concept of network interactions and how they work. That's a very complex part, because you need to know about anatomy, physiology, age, blah, blah, blah, and how the disease affects it to really understand that. In some way, people could almost look at us as dilettantes because, here we are, looking at systems. And if you look at a system, you need to include all those things; whereas, other people look at very small things.

What's interesting about that is the old law—I don't know if it's Boyle's law—that pressure equals force over area. If you want to make high pressure in a field, then you decrease the area. It turns out that the area of behavioral neurology is huge, so our pressure on the system is not as great as somebody who comes in who just looks for one disease, who is interested in one agent. I'm going to look at this agent or whatever it may be. That's always been a problem with our field, because we have such a big area that the pressure is not as great.

HR: [sigh] The term behavioral neurology was understood at one time, even maybe when Norman Geschwind – it has a certain kind of – people understood it. I think it's not always understood now. I don't know if that's because I'm in a community that doesn't

understand the term or if there's been a change. People understand cognitive neuroscience, which we haven't spoken about.

KH: Yes.

HR: And people understand dementia.

KH: But you see, even the word cognitive neuroscience is misnomer. Cognition is really knowledge. So what about emotions? What about attention? If we look at emotions, that's not cognition. So that's really a misnomer.

The reason Norman came up with that had to do with the American Academy of Neurology. They developed sessions—this goes way back—and they didn't know what to call the session that we now call the behavioral neurology session, so he said, "We'll call it behavioral neurology." It was so cute, because, in some way, this is a microcosm about what we're talking about, because the meeting would end Saturday at noon. So when did the behavioral neurology session come? Saturday morning. [laughter] So it would be Norm and I, Bob [Robert J.] Joynt, Andy Kertez, and Marty [Martin L.] Albert. He was also trained, by the way…Marty Albert. It would be a handful of us sitting around. But it was great, because we would have these great conversations. But he wanted to come up with, as I said, a term.

Even when they had courses—I didn't ask for this—I was the first one who gave the behavioral neurology course. They didn't have any courses or anything to do with it. I started the first one, which was a daylong course. It was interesting, because if you go back then and look at the number of people who signed up, it was huge, because there was nothing they could get at their own programs to understand this. So did we did things talking about aphasia. Most people were still talking about expressive aphasia. I would say, "Look! Norman taught me all aphasias are expressive." They have different things –

HR: I tell the residents at Chapel Hill that, but I still don't get it.

KH: Some are fluent; some are not fluent. Some have problems they mean, blah, blah, blah, but they all have problems with expression. That's what aphasia is. They said, "How about receptive aphasia?" I said, "It turns out, guess what, even in Broca's aphasia, a very complex syntactic sentence, they have comprehension problems." [chuckles] Everybody wanted to make anything [unclear] receptive expressive. No, it's much more complicated than that. So it's a long history.

[brief comment about video]

I think the issue is that when you talk about complex networks and information processing models, you're talking about very, very complicated modular systems that have a huge amount of interactions. Again, the pressure is force over area, and you're

talking about *large* areas, and it's really hard to focus on that, because pressure means focus.

HR: There's another tension, I think, thinking about cognitive neuroscience today. They've been extremely enriched by the tools of being able to look at the brain.

KH: Functional imaging.

HR: So, in some ways, that's been great, because there have been actually, even undergraduates, many more people interested in behavioral neuroscience, in a way. That's all good. But one of the things that I think—I don't know how you feel about it—may have kind of caused people to feel like that is where the progress is going to be made. But there's a difference when you're talking about neurology. I think there's an important niche that the neurologist's perspective has that needs to be… I think people understand us who are in sort of the top echelon of cognitive neuroscience are interested in these cases and these populations that really reveal something. One of the things, maybe, about cognitive neuroscience is you're working more often with normal populations, so you can come up with theoretical ideas, but you don't have experiments of nature that really test those ideas. So there is this important perspective you get from patients and as a neurologist, we have this opportunity to be in that space.

If we put in a grant where there's somebody in some cognitive neuroscience field where they've done studies in emotion and they have twenty publications on normal subjects for the past twenty years using a certain paradigm that they've been developing and, then, you propose your proposal and patients, it may not seem like you have the same lengthy track record in a very specific area. I think it's in part because, again, you're a little more spread out, but you're bringing things together from thinking about systems and neuroscience into the patient's domain. I just started thinking about this potential for positive interaction. Like at University of Pennsylvania where Anjan [Chatterjee] and Branch [H. Branch Coslett] are, I think the cognitive neuroscience program really appreciates them. Even if I don't go to the cognitive neuroscience either very much, there is only a small group of neurologists there. There was some recognition of that, at some point, where they tried to make a group that would meet there. So there is this small niche of neurology and cognition and behavior and you kind of want to know where they fit and how to help define that group so that people understand it better. I guess I'm interested in this, obviously, because it's my particular area. Or maybe you don't think it's much of a problem.

KH: Getting back to, really, case reports… H.M. **[**Henry Molaison] was a case report.[13]

HR: Well, a series.

KH: But case reports. I don't know how many papers, two hundred or whatever.

HR: Oh, many.

[13] American memory disorder patient.

KH: Yes, but it was interesting – when you talk about cognitive neuroscience, I mentioned to you I gave the behavioral neurology courses for many years at the Academy. We were out in California and I asked Larry Squire to give a talk about memory. He said to me, "Ken, would you mind if I talk about this stuff that I've just been doing with Washington University?" I said, "No, that's fine." This actually is published in the proceedings of the National Academy of Sciences. They gave people verbal memory tests and found that the right hippocampus lit up much more than the left.

HR: This isn't recent?

KH: No, no, no. This is goes back.

HR: Lit up? So what was he using?

KH: More activated. PET scanning. The right became more activated.

Again, like we talked about, the reason why it becomes more activated is because it's not used to doing this. It has to work harder to recall things. But, even going back, if you saw how many years ago with H.M. we knew about the hippocampus before functional imagining. And even with functional imaging now, can somebody tell me if the entorhinal cortex is a critical part? They can't. And they can't tell you so many other things that we first learned from looking at the dissociations. One of our important things is looking at the dissociations, so even with memory, the dissociations about verbal memory versus visual spatial memory or the thing about prosopagnosia versus object agnosia where the two hemispheres meet. The dissociations. What happens is neurology really lets you, even though we're looking at networks and systems, it lets you also fractionate. And it says, "This specific part of the brain has this specific contribution. This is what this module may be doing." The functional imaging studies are beginning to be able to do that, but with a lot more problems. Again, they need converging evidence from both…okay.

What happened was when I went to school I was always interested in the brain. I decided to take a course in psychology at U-VA. My wrestling coach, Frank Finger, was the one who taught it. This was the Introduction to Psychology. Back then—this was in the 1950s—B.F. Skinner ruled. It was all black box. You don't have to know what's going on in the black box. All you have to know is what stimulus goes in and what you reinforce. It doesn't even make a difference what you punish.

[chuckles]

KH: It was what you reinforced. When you look at experimental psychology, which is now called cognitive, they treated the brain like it was a black box, because they didn't have any way of looking into that box. They said, "Well, it's not really important." This really came from the whole idea of the anti-phrenological movement, the anti-Gallian concept of modularity. Then, all of a sudden, because of functional imaging, now these

psychologists have a way of finally looking into the black box, which we always had from the very, very beginning. We looked in the black box because we had people with lesions and, even before we had imaging, when they died, we looked to see where the lesion was and we could make statements about that. Now, they have it and they just love it, because now they really can get into it.

Again, there's lots of weaknesses in the imaging that they can let us know about. As I mentioned before, for anything, you need converging evidence, and the neurologists can provide powerful, powerful converging evidence that they can't get by themselves. I would think again, like in many places, like our institution and many other institutions, the neurologists and functional imaging is all working together to get this convergence of knowledge. I think it is really, really important, because the functional imaging can generalize this to a healthy population to see what these networks do. But, again, the converging evidence is really important.

HR: I went up in Montreal, as you know, recently. There's a woman there who is, I guess, the interim chair at the MNI [Montreal Neurological Institute]. She calls herself a cognitive neurologist.

KH: Who is it?

HR: Lesley [Lesley Fellows]… She trained at Princeton with, maybe, Martha [J. Farah], who does the amnesia. So she's done her Ph.D. in cognitive neuroscience. She's a neurologist. She's very nice. She gave a talk once at the Behavioral Neurology Society meeting at the AAN about frontal lobe lesions. She does this symptom amnesia mapping type of thing and looking at frontal behaviors and how that maps unto specific behaviors. The point is that she calls herself a cognitive neurologist.

It's interesting to me while people – the whole society that you partly founded—we can talk about, too—the Behavioral Neurology Society is kind of a satellite meeting at the AAN, which has been one of those forums where people interested in this topic can get together. There was some move to change its name to…

KH: It was really called the Behavioral Neurology Society. Then, they changed it to the Cognitive Behavioral Neurology Society. t

HR: Whatever.

[chuckles]

HR: It's true that you need to be understood. People need to know what your field is. If people have trouble understanding what behavioral neurology is, maybe this is beneficial to change something.

What's interesting is behavioral neuroscience is not problematic. People understand behavioral neuroscience. It's sort of animal behavior and cognition and all that kind of stuff.

KH: Right.

HR: But I think with the human behavioral neuroscience field, behavioral study, people start to think of psycho behavioral psychiatry, behaviorism, and those types of things. I guess that's what this kind of distinction has been driven by.

KH: The reason why I founded that society…

HR: Yes. When that was founded?

KH: Oh, I can't remember. It's been around for a while. The reason I founded it, actually, was for several purposes. The first thing was that when you took the board, the written boards, there was only behavioral question and the answer was incorrect.

HR: [chuckles]

KH: You had to mark the correct answers. They said, "If somebody comes in and can't read words but can write normally, which of the following do they have?" They closest was a left-handed alexia, when it should have been right-handed alexia. That was the only behavioral question on the whole thing. So I'm saying, "My goodness. This is not right for the boards." Then, the in-service, the same thing. There was no behavioral neurology on the in-service. The thing that troubled me is that we're saying to people, "This is trivial from the point of view of training, but also of clinical things." And I don't think it's trivial. I don't think it's trivial from taking care of patients.

HR: What matters to them, as you said, is their behavior.

KH: Even questions like if you come to somebody who has sub-acute or acute memory loss, you should know, "Hey, think about herpes." These are treatable disorders, on and on. So what happened was I founded the society for that.

[comment about video]

I'll tell you a funny story about it. I got assigned to be on the boards to see if we could add behavior to the board. So they had this combination of the section called behavioral neurology and psychiatry. It was actually an independent different sub exam than the major one. Bob Fishman was actually the head of over all thing. So for the first meeting, he said to me, "Ken, I'm worried, because some of your questions now are just not purely psychiatry but they're related to neurology. After you make all your questions up for the board, come and tell us what the questions are." So he wanted control over the other part of the board. The first one that came up is a patient who is an alcoholic. He comes in and has profound memory loss with confabulation. Then, he dies. Where is the lesion? The

choices were hippocampus, parahippocampal gyrus, and then the correct thing, thalamus and mammilary bodies. So Fishman says, "Why do you have this question?" I said, "Well, I think this is an important question." He said, "Any idiot can answer this!" So I said, "Bob, what's the answer?" He said, "Everybody knows the hippocampus is important for memory! It has to be the hippocampus." He sees all of us have this big grin on our faces. I said, "Bob, do you want to take another guess?"

[laughter]

KH: He said, "Okay, Heilman, you win. This is the end. Go ahead and have your own exam."

Actually, what happened was that exam, when I took it, not only was it just purely psychiatry but I remember one of the questions, and I said, "Why would neurologists have to learn this?" It was a woman who had anorexia. They asked, "What is the cause of anorexia nervosa?" On the list, they had fear of oral conception. I said, "This is so bizarre, I'm going to check this one."

HR: [chuckles]

KH: I came back and looked at the psycho analytics and they told the story about a woman… I don't know if you ever read this story. It's a *horrible* story about a woman on a dock and a man says, "Close your eyes and open your mouth." You got it. She never ate after that.

HR: Was that the correct answer?

KH: That was the correct answer. I'm going, "Why would a neurologist have to ever know that?" That was another motivation for doing that, so I made sure that the psychiatry part was really something that was really valuable and would relate to stuff like that. Don't misunderstand me; I love psychoanalysis and I love reading about the mechanisms, but to ask a neurologist a question about stuff like that, or ego and Id, all that really traditional stuff, I said, "They don't need to know that." Now, we left some of it on, but I'm saying the whole exam was nothing else.

[break in the interview]

HR: You're a clinician, an educator, an investigator and I think, also, a reader in this field. I'd like to touch on those different things starting with your work in your research, your work as an investigator. I think that's really important to have a chance to talk a little bit about some of your biggest contributions. There are so many different areas that you have five hundred-plus publications, 500! [chuckles] Most of these are really experimental research publications probing with specific hypotheses about specific questions. That's a lot of questions you've been looking into. So there are different domains that you focused on but there are several… The right hemisphere has been a big part of things. You did some work with prosody and, of course then, attention neglect

and that network, and, also, praxis. The Wartenberg Award lecture that you gave I think focused on the praxis story. Not only did you do those things, you've done work in language and memory. It's really been across the board and in emotion and different areas of behavioral neurology.

I sort of feel a little bit out of my element here in terms of knowing, because there's so much to cover, how we should start. I know you can talk about this research and, also, give a lecture on each of these topics. It's hard to summarize quickly. Maybe you could talk about a couple of papers that you sort of remember as being important from some of those domains. I'll just let you think about what you think you'd like to talk about first. I know for each paper, the ideas were generated from seeing patients. You have a story about how you decided then to ask questions. You might want to comment on why these papers are important. You have this book, *Matter of Mind*, which describes some of the ways you thought about questions when you encounter patients and then, subsequently, asked questions and probed these things and covered some of this research in a narrative form. Does that sound reasonable to pick a paper and talk about it?

KH: Well, maybe not a paper, but certain concepts.

HR: Good. Sure.

KH: I already told you the story about seeing that patient who had this neglect syndrome. The patient also had anosagnosia, which is another thing that we did a fair amount of research in. In general, in several of the important papers that we brought forth was the concept…. It's interesting. There's a tension when people talk about that. You'll see quotes saying, "Everybody knows what it is, but it's hard to define." So, in general, what we did is we defined attention as really a triad system, that the body and the brain are receiving too much information to be simultaneously all processed. There's not only external information but even internal information. What you have to decide is which information is the most important. So theoretically, how do you decide? There are three different ways that decision can be based.

One is on, let's say, emotions and drive, like fear or anger or hunger, all those things. Those are mediated by the limbic system.

Then, the second way that you can decide is goal-oriented behavior, what's going to be important in the future. We know that the frontal lobes are important for goal-oriented behavior. Then, of course, anything that's novel automatically has to be processed. Based on that, we came up with the idea that when you look at the parietal lobe and posterior temporal lobe, that's receiving, as we talked about earlier, mostly modal input from all the sensory modalities. Already, those modalities have an idea of what objects or what things they've perceived. We mentioned the idea about cingulate gyrus projecting to that area and that probably transfers the information about emotions and motivation. Then, also that area of the parietal and posterior temporal lobes is very strongly connected with the frontal lobes. So that allows you to know about the goal-oriented behavior.

Then, the other thing that we came up with is the concept also… It turns out that a lot of people talk about Leslie [G.] Ungerleider and Mort [Mortimer] Mishkin and the "what" and "where" system. But neurologists knew about that based on Lissauer's work of object agnosia from the ventral stream and from [Rezső] Bálint's work of the dorsal stream where patients had optic ataxia. They couldn't find where things were in space. So one of the things we also pointed out is like from the visual system and other modalities, the "what" and "where" system also converge in that area. When you attend to something, you have to know what you're attending to and where it is in space. So putting all those things together and converging them into this module, we thought that module was critical for attention for all of those purposes. That was a very important part of our work.

Then, we expanded that a little bit because it turns out that not only are you bombarded with information from the [unclear] side but, also, you have a choice of multiple moments, so you have to decide when you want to move, when you don't want to move, when you want to persist, and when it's time to quit. We called that intention, those four things.

Therefore, what we did, as I mentioned, we wanted to see if the monkeys and humans who had frontal lesions, whether they had more problems with intentional neglect than the attentional thing. So if you ablate a monkey's frontal lobe or parietal lobe and you present stimuli on the left side—let's say you ablate the right side—the monkey doesn't interact with it. Because the monkey is now weak, people said, "It's because they're unaware of it." But we brought up the hypothesis that perhaps they can be aware of it, but don't act on it. So Bob Watson, and Valenstein, and I, and monkeys, we trained them so if the stimulus came on this side, they would respond with this hand and if the stimulus came on this side, they would respond with this hand. Then, we made frontal lesions and, sure enough, they appeared to have neglect, not to respond on this side. But when we trained them, let's say, the cause response when the stimulus came on this side, they did respond with this hand in this part of space. But when the stimulus came on this side, they didn't respond even on the normal side. What we showed is that there is an intentional neglect. We think that was another important concept of intention, that you can have intentional disorders where you have akinesia, or failure to act, or a delay in acting, or an inability to persist in an action, and so forth with frontal lobe things as part of the neglect. Those were all things that we thought important in addition to bringing up this whole concept of network.

What we also did is we showed that there was a defect in arousal when you had all these neglect syndromes, because when you decide to process stimuli or to act, you have to have arouse the brain. It has to be activated. We showed by EEGs and other methods that it wasn't activated and also showed we can produce neglect by injuring a lesion in the reticular activating system in the brain stem, that they had it. So we showed that there's another element of it.

Then, we got a little bit into emotions, because people had noticed that there is a difference between emotions of the right and left. Part of a lot of emotions is arousal and increased attention. We showed, again, that this may be related to the same kind of disorder of arousal that those people have. So that's how we got into a little bit of emotion with the neglect thing and there were lots of other things from that.

The other thing about the right hemisphere… I should probably tell you little funny story just to break it up. Several years after I got here, I got a call from a neurologist down in south Florida. He was asking me about a patient who had a problem with language, with naming. I was ready to speak to him and he said, "Oh! I called the wrong place. Gainesville – that's the right hemisphere. I have to call Boston; that's the left hemisphere."

[laughter]

KH: It's true that we got into a lot of right hemisphere things.

The next thing about the right hemisphere that you mentioned is, again, this idea about seeing patients who give you whispers of nature. In the 1970s, I got a call from a physician. There was no neurologist in the whole Atlanta region. When you think about it, it's amazing. He had this woman who was comatose and was having seizures, but they didn't know why she was comatose or having seizures. This was actually just a little bit before they had CT [computerized tomography] scans. I said, "Load her up with Dilantin and send her up here. Sure enough, when she came up here, she had a low-grade fever. I did an EEG and she had phase reversals over the right parietal region. It turns out, she had an abscess right under her parietal mitral, and she got better.

Then, I brought her back to the clinic just to make sure that the Dilantin levels were okay. Acutely, she actually had some neglect. When I brought her back, most of the neglect was almost gone. The only thing she had was a little extinction to bilateral stimuli.

Then, I brought her back, again, I guess in about another six months. Her husband, after I saw her and said, "She looks better," was giving me one of these nodding motions that he wanted to see me outside. I said, "Please, tell me in front of your wife. She's my patient." She said, "It's okay if you want to speak to him outside." So we went outside and I said, "What's the problem?" He said, "My wife and I no longer have a meaningful relationship." I said, "What do you mean? She's your wife; what do you mean by meaningful relationship?" He told me the story that he opened a store near Disney World. Disney World had just opened. Then, there was this artificial oil shortage during the [President Richard] Nixon Administration when they kept all the ships out. Do you remember this? All the oil prices really rose high and nobody was coming to Disney World, so he was going belly up and was very depressed. He said, "She doesn't even recognize that I'm sad."

So I came back in again. I remember I think it was Brenda Milner who did some work giving people The [Carl Emil] Seashore musical ability tests and showed that people with

right temporal lobectomies had problems with melody and tamber. I said, "This hits the posterior portion of a temporal lobe and the parietal lobe. To recognize emotional prosody, it's tamber". I just gave her a couple of sentences and said to her, "Tell me what emotion I'm portraying." These are not the exact sentences, but I said something like, "The boy went to the store." [Doctor Heilman speaks in a sad tone] She said, "Happy." I said, "Why happy?" She said, "Well, watching a boy go to a store…" She had no idea about prosody. All she was doing was listening to the verbal propositional message.

So I was ready to write that up. Dawn [Bowers] was with me. She was more of a scientist than me. She said, "We need to get a population." So we got a population of right hemisphere damage and left and we showed, clearly, that they had problems with prosody. Then, we also showed that they had problems with expressing prosody. Then, Steve [Steven T.] DeKosky, when he was a resident here, he did the things with faces and showed with the faces. So we showed that although the left hemisphere is important for propositional speech, the right is important for emotional communication. Later on, Elliott [D.] Ross did a lot of beautiful work separating the expressive and receptive things. That, again, was the right hemisphere type of stuff that we made some contributions with emotional communication—and we're still doing work on that, as you know.

Some of the stuff we did with left hemisphere, it turns out—you're right—was with praxis. There were several things… When I was with Norman, Norman had a lot of interest in praxis and that came from Edith. He would always ask me, 'Is this person apraxic?" If I said, "Yes," he would say, "No." If I said, "No," he would say "Yes." [chuckles] I'd say, "Wait a minute." He used to use the word "clumsy." I said, "What do you mean by clumsy?"

So one of the things when I got here, shortly after Leslie [J. Gonzales] Rothi] joined us, we got together with Howard Poizner, we put LEDs [light-emitting diode] on people's arms. What we actually did was show the nature of the movement that's associated with ideomotor apraxia. That was, again, showing what the real nature of the errors were.

As far as localization, Norman thought it was a verbal disconnection and said that the reason why people get apraxic in supramarginal gyrus in the left hemisphere is like a conduction aphasia. They understand the command. It's in the areas, but they can't get it to the pre-motor areas. I remember asking him, "Why can't they imitate?" He said, "Well, that pathway probably goes to the same." I said, "Why can't they use their right hemisphere?" He said, "It appears something is dominant on the left hemisphere." That didn't all make sense to me. It turns out that [Hugo Karl] Liepman actually talked about movement representations but never really explicitly mentioned it, so we said, "Maybe the parietal lobe does contain these visual, spatial, kinesthetic movements so that you know how to move your arm."

Then, Leslie and I did that paper where we looked at people with posterior lesions and anterior lesions and showed that the patients with posterior lesions not only could they

not properly make the correct movement, but they couldn't even recognize other people's movements, whether they were correct or not; whereas, the people with the interior lesions, they couldn't make correct movements, but they could recognize it.[14]

HR: What about imitation?

KH: The same thing. Both had trouble with imitation, yes.

What was interesting—we were talking about it earlier—was converging evidence with imagining. We said that these representations are probably in the inferior parietal lobe, most likely the supramarginal gyrus. Then, when functional imaging came out, lo and behold, that's the where they showed that's the area that contains those memories.

Then, we said, "What's going on with the frontal lobes?" We talked about the SMA [supplementary motor area] versus the premotor cortex and did further things separating what those two areas did.

Then, we expanded into a whole bunch of other types of praxis disturbances. So, also, we became interested in knowledge about tool knowledge and mechanical knowledge, and demonstrated that patients with dementia and left hemisphere disease not only have a problem with the visual, spatial, temporal parts but even knowing about what tools should used for what and mechanical advantage. We termed that conceptual apraxia.

Liepman also talked about limb-kinetic apraxia. One of our former fellows, Brenda Hanna-Pladdy, came up with that little test of the coin rotation. That paper came out and showing the new test she developed.[15] I was the co-author, but she was the one who really brought my attention to it, and, again, looked at the areas important for that, which is the premotor cortex and motor cortex and not the posterior portions.

So we've done a lot with praxis stuff, which was left hemisphere. So those are the three major domains where we did a lot of things. Of course, there were a lot of other papers about memory. It was really Ed Valenstein and Bob Watson and I who wrote that paper about the retrosplenial cortex showing that that's a critical…[16]

HR: That wasn't from monkey work?

KH: No, no. That was done from human, one patient, again, who had an [unclear].

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[14] Torres EB, Raymer A, Gonzalez Rothi LJ, Heilman KM, Poizner H. (2010) Sensory- spatial transformations in the left posterior parietal cortex may contribute to reach timing. J Neurophysiol. Nov;104(5):2375-88.

[15] Hanna-Pladdy, B., Heilman, K.M. Foundas A.L. Cortical and subcortical contributions to ideomotor apraxia. Brain 124:2513-2527, 2001. Correct citation?

[16] Heilman, K.M., Bowers, D., Watson, R.T., Day, A., Valenstein, E., Hammond, E., Duara, R. Positron emission tomography (PET) in a patient with retrosplenial amnesia and abnormal orienting. Neuropsychologia, 28:161-169, 1990. Correct citation?

HR: That's been shown now multiple times.

KH: Everywhere. Even Alzheimer's patients have degeneration of it, so that's a critical area.

Then, [Lynn J.] Speedie and I in another case report had patients with right and left thalamic lesions and showed the left ones had verbal memory and the right ones had visual spatial memory disturbances. So we did a lot of things with amnesia and stuff like that.

In the language stuff, we described several new syndromes. Just to give you an example, there's a disorder called optic aphasia and patients with optic aphasia, what they can do is when you show them something like a pen, they can't name it but it's not an agnosia because they can tell you, "You write with it. You hold it in your hand," and so forth. But if you let them feel the pen, they can name it. So what it was thought to be was a disconnection between the visual object recognition areas and, let's say, Wernicke's area or someplace.

HR: Was that something that [Sigmund] Freud described? Is that the optic aphasia? No.

KH: I don't know who do it.

We saw a patient in the clinic… We saw several but the first one we saw was a patient who came in—it was really, really interesting—who had a lot of language problems. The wife said that he didn't comprehend very well. One of the first things we did, because we thought it was a degenerative disease and thought it was Alzheimer's disease, we gave him the Boston Naming Test. He scored something like 59 or 58 on it. We went, wow! He can't be impaired, because naming has always been the weakest link. We gave him—I'm making this up; I can't remember exactly—maybe the odd ones to have them named and the even ones, we described it. So instead of when showing him a tree, we would, "It's a plant that has bark and leaves. What is it called?" He had no idea what we were talking about. So we called that non-optic aphasia, which is bad term. You should never call anything non. The idea was now that you had the opposite. What that really suggests is that he could name without semantics, so when he saw the object, he probably was going directly from the object recognition units [unclear] lexicon without going through semantics, suggesting that you can name two different ways. That made sense, because if we drew a fake object and gave it a name and you have no semantics and I say, "This is a flig." Then, if I said, "What is this called?" He would say, "Flig." I say, "Tell me about fligness." He couldn't tell me, you see. So we did things like that. In some ways then, we really altered the classical [unclear] Wernicke models to include all these different types of naming things. So that's some of the stuff we did with language, which was another domain.

HR: I remember we had a case together. A man who could name by sort of using his whole-word pathway. I don't know if you remember him. If you gave him phonologic

cues, he was miserable. It was almost like he had a different route to speed production. Thinking about the different modules and how they interact, helps to see these dissertations.

KH: Again, the concept of all these things goes really back to some of the problems we talked about earlier, about Gall, that we were really looking at these in a different…so object recognition units. Something allows you to remember things you've seen before as objects. Then, we talked about the [unclear] lexicon. You have this kind of pronouncing dictionary. Just like when you open a dictionary, the first thing it tells you is how to pronounce the word. It doesn't tell you the meaning. That's later on in the dictionary. You can get from the visual object units directly to those output things without going through meanings.

The point about that all is that there are different modules and different diseases can differentially affect these different modules and, therefore, give you different symptoms. Those are some examples of the things that I gave.

HR: That's great.

There was a series of lectures that you did here on behavioral neurology. One was on praxis. One was on language. Maybe we should attach those. Do you still have those lectures?

KH: No.

HR: Maybe I should find out who has them.

KH: I don't think anybody does. I don't thing anybody saved them.

HR: I'm sure they did. I think Mike [surname?] was involved in recording them. It was a series of ten.

KH: Yes. I don't know if they ever saved them. Marty [Martin A.] Samuels gave a lecture that they were going to use and recorded it.

I've got the recording of the presidential thing.

[chuckles]

HR: I'm going to track those down. I think we'll be able to find them.

KH: Tee keeps on saying, "We ought to, blah, blah, blah, do something about it."

HR: You did ten lectures here and it was recorded by the institute downstairs in the big lecture hall.

KH: I don't know what they did with them.

HR: I'll check with Mike on that. It would be nice to have those.

KH: Tee keeps on saying, "We need to do that, get those ten lectures down…"

HR: I remember you did them. We'll find them.

KH: Okay. [chuckles]

HR: Anything else you want to mention about the science and your contributions there?

KH: It's hard, because there are a lot of papers. Again, some of the things weren't just based on behavioral neurology, like we talked about earlier, [unclear].

It was interesting actually… One of the papers, early on, that was very much quoted was I saw a patient who had lupus and she developed unbelievable chorea for movements, which you can get.[17] She couldn't do anything in life. They called me up and said, "What is there to do?" I said, "Well, there's this theory about chorea being a hyper dopa allergic state. If we give people too much dopa [dopamine], you get chorea for movements. So why don't you try and give her a little bit of Haldol, a teeny tiny amount?" Of course, we reported that she got better. [chuckles] It was interesting how many of your own textbooks recorded that and said, "If you see somebody with chorea, give them a dopamine blocking agent." That was something a little bit different.

So we have actually a couple of case reports even with patients with different new diseases that hadn't been reported and treatments and so forth, which is general neurology, not just behavioral neurology.

HR: You've been incredibly productive in the scientific literature. Part of that is writing things out and getting things published. Part of it is asking questions. Do you want to comment on how you think you were able to do that?

KH: Well, let me tell you something else—to put this in the recording. Heidi [referring to Heidi Roth] was a post-doctoral fellow and one of the ways I have been really blessed, really blessed – from the time I got here, there have been residents and fellows who have been unbelievably productive, as I was telling you about Bob Watson, who was a resident when I came here and Ed Valenstein, who was even a resident underneath me. You know, we have been so blessed with so many fellows, so a lot of the stuff that's even attributed to me was whispers of nature that they saw and maybe I guided them. So I've been really unbelievably blessed with having wonderful trainees, residents, and fellows. A tremendous amount of these contributions are really, I mean really, related to them.

[17] Heilman, K.M., Kohler, W.C., LeMaster, P.C. Haloperidol treatment of chorea associated with systemic lupus erythematosus. Neurology, 21:963-965, 1971.

Yes, I helped mentor them and maybe said, "This is interesting. You need to pursue this." But a lot of that creativity is not mine. It's really sharing with other people. That's really, really important. In fact, when I wrote that book on creativity –

HR: Yes, yes.

KH: …right in the beginning of it says, "Dedicated to the fellows." because they've had such a…

BWS: I'd love to hear the beginnings of it.

HR: That was the beginning, where you dedicated it to…

KH: I had the list of all the people that I worked with all those years, people like Heidi coming down here. It's interesting, there were so many of them. I remember, for example, Anjan [Chatterjee]. Anjan's heritage is Indian. He went to Penn [University of Pennsylvania] to medical school. He didn't go to college there; he went to a small college in Pennsylvania [Haverford College]. He was an All American runner, actually.

HR: Really?

KH: Yes. He took his residency at the University of Chicago. He wanted to come down here, but I couldn't take him that year, so he actually spent a year with Peter Whitehouse up in Cleveland [Case Western Reserve University]. He came down to interview and he was sitting on my couch. It's the first time he had been down South. He said, "I'm kind of a dark Indian. Do you think I'll have problems in Gainesville?" I said, "Anjan, I think you'll have more problems in Chicago than you will in Gainesville.'

[laughter]

KH: I said, "This is a very progressive community." The thing was he was really frightened to come down here. Here was the Deep South.

When you really think about all the people that came from different places, it was really courageous for them to do it, because here was Gainesville. I remember, even myself, when I decided to come here—I got those offers to stay at Harvard and Dartmouth—I said, "I'm going to Gainesville," and how many people gave me this look. Where?

[laughter]

KH: I've been really blessed with some of the most brilliant and talented people over the years—and they're still coming. A lot of that creativity has really depended on them.

HR: They are incredible people, too, but I think you're being a little humble. I know if I interviewed Anjan or Branch, something they would say about you is that you have this incredible ability to look at a patient and say, "Look, this is the interesting thing about it.

This is the interesting thing this is telling us." I know that they really see that you're unique in that way. I think you offered something very unique to us.

KH: Yes and no. They *came* here. They came here just like you because they read the papers and said, "Wait a minute, I like this approach." They had that mindset already. If they wanted to just suck out cataracts and do nothing else, they wouldn't have come down here. Do you understand what I'm saying?

HR: [chuckles] Right, right.

KH: If they wanted to do EMGs [electromyography] all the time and stick needles in, they wouldn't have come down here. So they had that mindset already.

I remember, even, Branch really didn't know much about behavioral neurology. He met me at a U-VA party. Maybe I was a visiting professor up there or something like that, and it turns out that they presented a case of with pure word deafness. We actually wrote it up; it was an interesting case. It was bilateral lesions. He always had been interested in neuro behavior. After I gave a lecture and talked about this case presentation, he was like, there's some place they do this! He was already an assistant professor there. He quit his job and came down, went backwards, and took a fellowship, because he said, "This is an opportunity for me to do things that I'm interested in."

So, yes, I helped maybe develop, but those people were all so brilliant and creative and with the potential to do that. The reason why we're joint authors on these things is because they were really joint projects, so I'm very indebted to my fellows. Even in retrospect, if you asked me—we're talking about education now—about my contributions and some of my joys, there would be *no* question, that would be very high up there—and you know that.

HR: I know that very much. I think that's a wonderful legacy. I think that's also something that stood out. Many, many, many of your fellows have continued in your footsteps. I think that's a testament to your wanting to train them and being very generous with training them to a point where they can actually do their own work in an academic kind of way.

KH: One of those books in high school was [Kahlil] Gibran and he said, ""Raising children or being a teacher, or whatever it is, is shooting a bow and arrow. You aim it very carefully. But once you let go, it has to fly by itself."

[laughter]

HR: I know when I was looking at fellowships, one of the things that struck me is that the people who had trained with you continued to work in the field and remained enthusiastic, continuing in behavioral neurology. So I think that's important.

I was going to say one more thing, though. Having been there as a post-doctoral fellow, what I remember, too, is that every time we saw a patient it was like, "This is something you could do." "This is something you could do." There were always about fifty things that were all interesting. That was also part of the richness. You presented a lot of the curiosity for the questions that came up. There were *so* many things to investigate that were unknown. I think that's a very powerful thing. In medicine or science today, you feel like you have to know the thousand papers that have been written on this topic before you can get started. What you could see—at least I felt having been here—is you could see a patient and say, "There's a question here," and start thinking about what approaches you might have to answering that question or learning something about that person without being overwhelmed with having do ten years of work in one particular area. I think it gives people a feeling that they can answer questions using tools that they have.

KH: Let me tell you a Heidi [Roth] story. A couple years ago, a woman died and her family wanted to have a postmortem examination. So we have pathologist, Tony [Anthony T.] Yachnis, and he cuts the brain and he sees all this demyelization. He says, "I better get the records. She was seen here." He opens up this record and he sees this *unbelievable, beautifully detailed* examination of this woman, who had a dementia, but had no cerebella findings. It turns out that she had something called fragile x syndrome, and no one has described her combination of things and here is this most beautiful detailed note.

HR: I still suffer from that problem.

KH: The sixteen pages?

[laughter]

HR: I saw a patient last week, nineteen pages.

[laughter]

KH: Tony Yachnis, when he saw that, he was like, "Oh, my goodness," because he couldn't think of any clinical questions that you didn't answer and we saw her relatively early compared to later on in her condition. Guess what. Every one of those people who have had cerebella peduncle involvement, they were ataxic. She was never ataxic.

HR: She had more sort of Parkinson's.

KH: That's right.

HR: That's interesting.

KH: That was another new disease. We are talking about having new diseases that we described.

HR: I think, also, you, having worked in other conditions and different departments, have a lot of enthusiasm and positive momentum. That's important in science, too.

KH: Oh, yes.

HR: You mentioned how Ed Valenstein was kind of your counterweight.

KH: Yes, he was.

[laughter]

HR: I don't think he would have been able to push anything without you, right?

KH: I wouldn't say that. I certainly encouraged him.

HR: Right. Exactly.

[laughter]

HR: I remember stories about him and how much he could be aware of, being critically minded. He was very critically minded. That can paralyze some people.

KH: As a matter of fact, you know it was really interesting, because when we saw this retrosplenial case, I said, "It's interesting, because we've got to really find out if it's exactly the retrosplenial cortex of if it's not [unclear]." I wrote up a grant with him, which was funded, an RO1 in monkeys.

HR: I thought there was a monkey part.

KH: Well, but here's the interesting part: there are no papers. I'll tell you why there are no papers.

HR: [chuckles] I just want…

KH: What happened was—I'm making up these numbers—like eight and eight monkeys, eight who had controlled lesions, eight had this, eight had that. In seven of the eight monkeys—we restricted the lesions—the retrosplenial cortex had problems among the memory thing. There was one who didn't. I said, "Ed, that's okay. Publish the paper." He said, "I'm not publishing this." I said, "Look! You've got eight [unclear]. You only have one statistically binomial things, blah, blah, blah, and you have controls." He says, "No. If it was the retrosplenial cortex, there would have been all eight in all of them." I said, "Give me the data, and I'll write it up, and put your name on it." He said, "I won't want my name on it. I'm not going to give you the data."

[chuckles]

KH: Guess what.

HR: It never got published.

KH: It never got published.

HR: I think I've heard that story. I certainly remember the monkey part of it.

KH: I said, "Okay." Even later on in his life, I still bugged him. I said, "Do you still have those slides? We did all the histology. We sacrificed those animals. This really troubles me. We'll just tell them what is. We'll say seven out of eight and just say there's a problem." He says, "No, there's something unexplained. I will not publish it." It was the same Ed Valenstein.

HR: This is sort of interesting. When you go back to old literature, you realize none of these cases were perfectly pure. So sometimes people don't understand that you have to look a little bit at what the relevant question is and some things may be variable to get a sense that this matters. This is what's the important story here. If you go back to Wernicke's cases or Broca's…

KH: There's no question…

HR: …or [unclear] case, the praxis, Mister T., Liepman, these were not perfect cases but they knew what the important story was.

KH: But what's interesting—we often talk about this still in our lab meetings—is that in medicine, we always want something that's pathognomonic, in the sense that we don't really like statistical models. You're not a little bit pregnant, you're pregnant. You don't have a little bit of syphilis. If you have a spirochete, you have syphilis, and on and on and on. What happens is from psychology, we take a statistical approach. Whatever it is, all these things, drugs, we take a statistical approach. What happens is the purists like Ed, say, "Yes, even though the statistically that would be there, it is not pathognomonic." If this place was critical for memory, when we ablated that area, it should have caused…: A lot of us had been trained that way in the sense of saying, "If this area is critical for doing this function, there's no reason you should have to do statistics."

HR: There's an exception that completely negates the other findings.

KH: That's right.

HR: That's so fascinating. It can be a mistake, as you know. Speaking of monkey literature, after H.M., they tried to replicate that whole finding and they couldn't. Why couldn't they do it? They did these lesions in the hippocampi and the monkeys still remembered the stuff they were showing them. It turns out they didn't really understand that they were using a task that in monkeys was procedural learning and didn't require the hippocampus.

KH: That's right.

HR: It wasn't until they got the delayed double matching sample. So sometimes you need to not throw things out if you find one exception for things like that.

KH: You're preaching to the choir.

HR: A funny thing…speaking to a researcher recently, he was like if there's not exception in your data, then I don't believe it. Nothing is perfect. We're biological systems.

KH: Do you know something? This smell thing [re: peanut butter test, Jennifer Stamps] that we put out, I'm very worried about that.

HR: Why?

KH: Because it was too positive.

HR: Yes, you worry about that when it's too clear.

KH: The person is honest, but you're going… What happens is I didn't do it myself, so you worry.

HR: Was there a bias of some kind?

KH: I understand that. But with Ed, I said, "Look, Ed, put down what is, because you have information there. You're not providing other people with that information." He said, "No, because people will read that and saying that we proved that and we haven't proved it." He was really stubborn about this.

HR: But also brain organization is variable, so lesions are not perfect.

KH: You sound like me. Maybe that's because I trained her.

[laughter]

HR: I wanted to point out that many post-doctoral fellows have recognized your unique ability. Many of them are brilliant and have done very nice independent things. They all recognize that…

KH: But they all came here for that.

HR: Yes.

BWS: They came here and you provided them with…

KH: No, no. They came here because they knew about that. If they didn't want that approach - having read my papers, they knew about it before. If she [referring to Doctor Roth] didn't want that approach, then she wouldn't have come here. If that approach didn't resound, resonate…

HR: I think one of the things I always like is [unclear], the fascination of the experience of the people and what they show is just incredible. I think you're been interested in that, too, starting with what the patient experiences are. Sometimes in the context of medicine today, it's a little harder to do that kind of thing.

KH: Yes, and what a shame.

HR: Maybe you just want to speak a few words about… I know you're still active in your research. You apply some of these ideas you've been thinking about for a long time about current issues. You've done work in Parkinson's disease and you've had some really interesting observations thinking about some of the cognitive behavioral changes in Parkinson's disease from a neuro-system's point of view, even the language components of it, and some of your more recent intersts. I don't know your age but you've been here and very productive for how many years now?

KH: Forty-three.

HR: And you just got two new grants, an RO1 and a VA merit grant?

KH: It was an R21 and a VA merit grant. We got three career development awards, which are like KO1s.

HR: Wonderful.

KH: Adam [D.] Falchook got one, who is a young neurologist.

HR: I remember meeting him at the AAN.

KH: And John [B.] Williamson got one and Susan Leon, who is a speech pathologist, got one.

HR: Great! That is fantastic. So people continue to thrive here. You are a leader here.

KH: Well, thank you.

HR: I wanted to speak a little about the leader business in kind of a national perspective with the AAN and that kind of thing. Let me give you an opportunity to talk a little bit about what you're doing now. We know it's not all in the past. You're continuing to create and produce. I know that you really plan to continue.

KH: Oh, yes.

HR: Why don't you speak a little bit about some of the things you've been thinking about?

KH: One of the newer things that we've been doing research on for several years now is creativity and what the neuro mechanisms are. One of the things about humans that really separates them from any other organism is their ability to be creative. So we've been doing a fair amount of research on that.

Just to give you some examples… David Beversdorf… About the same time he was a fellow here, my baby daughter—the one who is the attorney—was, I think, a senior at college here. She went to school here. She had dance when she was in elementary and middle school and so forth. She would always dance in the *Nutcracker*, so she liked Tchaikovsky. I'm making this up…the Moscow Symphony, something from Russia came here, and they were doing Tchaikovsky's *Pathétique*. So I said, "Eden, do you want to go?" She said, "Yes." So I got two tickets to go to our Performing Arts Center here. During the intermission, I was reading a little bit about the *Pathétique* and Tchaikovsky, things I didn't know. It turns out that he didn't name it the *Pathétique*. It was actually his brother who called it the *Pathétique*. He committed suicide about one week afterwards. I was kind of shocked. Here he writes this beautiful thing. I would have been euphoric and here's this guy that commits suicide.

I happened to mention it to a psychiatrist friend of mine. I don't remember which one. He said, "All those guys…" I said, "What are you talking about…all those guys?" He said, "If you look at all those guys, they have depression or bipolar disorder." I said, "Really?" So I started going through the literature and, sure enough, whatever domain of creativity you go into, the rate of depression and bipolar is enormous.

So I started thinking about that. I think there are several things about it. One of the things, I think people who are depressed sometimes have a deeper desire to understand meaning. So that was one of the things. I think sometimes creativity itself is an anti-depressant. Just like I get euphoric when something works. It's an anti-depressant.

Then, I started thinking about some things that I've been interested in and one of them had been the effects of norepinephrine. For a long time, years ago, we got interested in people using things like Ritalin and those things for attentional deficit disorder. If you look at what Ritalin does, it helps attention and it orients attention outwards rather than inward, but creativity has to be inward.

Then, I started reading more about it. The other thing that was really interesting is that when you look at any great paradigmatic change, it was always during times when people were really relaxed. So besides being depressed, they happened to be relaxed.

If you look at Isaac Newton in the apple tree, it's true. The reason he was up there in the apple tree was because there was a bubonic plague at Cambridge. When he was in the apple tree, he didn't invent gravity; he actually developed calculus.

[chuckles]

KH: If you go back to Darwin, he was on the *Beagle*. Archimedes was taking a bath when he yelled, "Eureka."

HR: I'm not sure being on the *Beagle* was really relaxing though. [laughter]

KH: Even Einstein, he did those things late at night when there was nobody around in the patent office. You can go on and on. Even [unclear] would search and starve himself and, finally, he gets by the [unclear] by the river and has his relaxation.

Those are low norepinephrine states. I said, "Could it be that what norepinephrine does"—I got some physiological stuff like this—"is it constricts the size of networks?" When you think about creativity, it's a question of really expanding the networks and connecting them.

What David and I did is we gave people this anagram test. We gave it to them either off Endirol or on Endirol. We were using other medicines to try and do it, but the major thing was that when there were all on Propanolol, they got the answer much quicker. Then, I found it was really interesting because years ago, somebody had published something that there was a lot of very bright kids who were taking the college board tests, or the SATs they call them now. They did very poorly because they had tremendous anxiety. They could answer the crystallized questions. But I remember - no one taught me this, but whenever I took an exam, first I answered all the easy ones, and, then, I'd come back and get the medium ones. When I was more relaxed, I'd get the more difficult ones. And these people were having more trouble with the difficult ones because they were very test-anxious. They actually gave them Propanolol and they did better on the exams than the other way. That went along with this idea about creativity.

So since that, we've been looking at creativity in many different fashions and forms and writing papers and publishing different papers on creativity. So we're still doing that now.

Another interesting part of it has to do with dyslexia and visual spatial creativity. A tremendous amount of artists, even Einstein, were dyslexic and they used very visual spatial types of stuff. So we've written several papers about this. I work with a person [given and surname?]—I don't know if you met him—up in Boston. The students actually measured the corpus callosum of people who had greater visual spatial creativity and showed that it was actually small.

HR: Just in the news, they published some thing about Einstein having a bigger corpus callosum.

KH: Which goes against what we thought.

HR: Because it should be smaller?

KH: The posterior portion. I'll have to look at that. It turns out that Einstein had a huge right frontal lobe.

HR: Oh.

KH: Yes, which is important for divergent thinking.

HR: Interesting, Bruce [L.] Miller's ideas. Fascinating.

KH: So we're looking at a lot of that.

HR: That's probably hard to get funded.

KH: Yes. We haven't been funded for that. We put in for one to NIH [National Institutes of Health] where we were going to look at aging. For some reason, there is this thing about aging and the decrease of creativity. In certain areas, like in mathematics, you're done by the age of thirty-five in theoretical physics. The nice thing about medicine is that you keep on going and in the arts, also.

[chuckles]

KH: We did some study on divergent thinking with older and younger people. It turns out we gave them this alternative word test—it was actually Susan Leon who did it—alternative uses. So tell me the things you can do with a brick and the more divergent answers, you got more scores. The older people actually did better than the younger, but we're thinking it may be because they've had more experience using a brick, but we don't know. So we're doing a lot of stuff on that right now. That's one of our things that we're doing. Again, I'm going to try and put in for another grant on [unclear]. That's still interesting.

Another thing that we got funded for from the VA is looking at vertical attention. Years ago, we described cases that had bilateral ventral lesions who had neglect of upper and we had bilateral upper with neglect of lower. These were actually case reports. One of the things we're interested in is what happens with aging and, then, what happens with lesions and so forth in different diseases with variable[?] attention. What's really interesting is that with aging… We just submitted an abstract on this.

Years ago, Dawn Bowers and I… This is one of most quoted papers we have, this thing about pseudoneglect.[18] It's amazing. Normal people, if you have a line like this and you

[18] Bowers, D., Heilman, K.M. Pseudoneglect: Effects of hemispace on a tactile line bisection task. Neuropsychologia, 16:491-498, 1980.

ask them where the center is, normal young people tend to deviate to the left. As people get older, it goes away and some even deviate to the right. The question comes up of this thing called [sounds like Hair-oh] phenomena, but there's a lot of evidence that the right hemisphere with aging may have more of a detriment in the left. So the idea was that the left bias was because of the right hemisphere dominance in attention.

The other thing, also, with aging—I don't know this—but one of the theories we have and we're looking at it is that in the parietal regions over here, even before Alzheimer's, the "where" system may be weaker than the "what" system.

People also have vertical pseudoneglect, so if you give normals a line to bisect the vertical and they do a little bit above center… Sure enough, we gave it to elders and, guess what, they're higher up. That's pragmatically important because older people trip and do all these other things. It turns out that their attention…

HR: I know we've talked about this before, but it may at least cross with local attention and global attention. That certainly has consequences.

KH: That's right.

So we're doing that and even looking at other things. If you tell…

HR: [unclear]?

KH: Even this from the intentional point of view. If you say to most normals, "I want you to close your eyes and make believe there is a line in front of you with two dots, one above the other, just at midline [unclear]. Put one hand on one dot and a hand on the other dot." Almost all right handers will put that hand on the top dot. No one has ever talked about this. Why do right-handers? When you really think about it, even about the concept of handedness…

HR: I visualized before you said it.

KH: …is that when you use tools, you always use them with gravity. So the left hand usually ends up holding the right hand…hammers. [laughter] Wood chops. An ax. Or beats things. It's always the one that's on the top. You don't scramble eggs [unclear].

HR: It's opposite of the hemispheric prediction, right? The right hand would be left hemisphere, which would be down.

KH: You would think that would be correct, but with the handedness thing, it has to do with, again, egocentric and allocentric. So we don't know. We're looking at it.

HR: Interesting.

KH: We're trying to find that out. You're correct: a lot of things like writing and so forth, are down.

HR: We did that experiment, you remember, the [unclear] experiment where left hemisphere bias was…

KH: I feel bad about that KO1.

HR: Don't think about it.

KH: It still bugs me.

HR: One thing I'm trying to learn, still, is when you write a paper and it gets rejected to send it out again. I didn't really understand that process when I started.

KH: You're too sensitive.

HR: Well, I just didn't know that that was [unclear].

KH: [unclear]

BWS: I know. You're mentoring.

KH: One of the things that has led to my success is I'm insensitive so when somebody insults me –

[laughter]

HR: That's a good [unclear]

KH: That's true.

HR: You act on it. You take in the information but don't dwell on it.

KH: It never goes internally.

[laughter]

HR: Another researcher I've been working with recently in Boston was saying, "When I write a paper, I write a list of ten journals. If I get it in by the sixth journal, that's great. You just have to understand the process." I was like, oh, really? Is that what you do? He's very successful and he loves what he does.

KH: If I think something is important, guess what.

HR: He said, "Not everyone recognizes it the first time." I know you've had some interesting rejection letters.

KH: Oh, huge amounts.

HR: Do you have little tour of good ones there?

KH: Even the one I told you about with the Parkinson's where they said, "Here is the last author..."

HR: Oh, right.

KH: He's only been publishing for…

HR: This is it. We talked about this before, that grand review. It was not long ago, right?

KH: It was about six, seven years ago. We were looking at why Parkinson's people have a change in their motions. One of the reviews of this blastomy part said, "I don't know why Doctor Heilman is the principal investigator. He's only been publishing papers for one or two years." We ran out of room. On the top, it did say, "He has over 500 published" or 400 or whatever it was then. Then, he said, "Not only that, but he's the last author on all these papers." We go, "This is really peer review."

HR: Right, right.

We've talked about this, too. You can get a committee who doesn't understand your area of work. Science is specialized. There are different methodologies. People are used to asking questions in ways in their own field. Actually, that's something they should tell people early on, that there may be people reading it who don't understand what you're doing. You just have to send things out again.

KH: There is no question. Going back to Norman again… It was interesting because Hauser, the same person we talked about earlier, wrote another editorial…

HR: Steve.

KH: Yes, the one that was the editor of *Annals*. He wrote an editorial where he wrote that there hadn't been a quantum leap, a paradigmatic shift in neurology—I'm making the number up—for, let's say, twenty years. In his thing, he said that what we need to do is that academics have to work closer with industry. I read this thing and I'm going, "Oh, my goodness." So I wrote a letter—you can get it; go into PubMed—and what I said in the letter was some of the stuff we had talked about. First of all, that with NIH, they never still done a study on reliability, that if you give it to two different study sections that were similar, and without reliability, you can't ever have the validity. The next thing,

they've never done is a study on validity, so take several study sections, fund whatever you're going to fund, fund the next equal amount and, then, five years later…

HR: See who's more productive.

KH: That's right. I'll bet you the second one is more productive. Then, I said, "The third thing is as money gets tighter, people become more conservative." So the idea of the R21 was the idea that to get pilot studies. If you send an R21 in now, what do they ask you for?

HR: Lots of pilot work.

KH: Now, if you had something that was a paradigmatic shift, like we were talking about earlier, and you had eight people that you treated with this medicine, and you cured glioblastoma multiforme, would you send it in or would you publish the paper? You'd publish the paper. So if you have a paradigmatic shift, you're not going to wait and keep on doing those types of things. So I wrote about all of that stuff.

But at the end, I told the story about Norm Geschwind and Bob Joynt. We were having lunch after one of the Academy meetings. It was in Saint Louis. We were actually having it in the Budweiser place and drinking Budweiser beer. We were talking about NIH. Now what was happening was that the amount of MDs were shrinking in the percentage of grants tremendously. We were talking about study sections and so forth. This was way before Hauser. He [referring to Norman Geschwind] said, "The problem again is that the funding agencies and these study sections are not going to take big risks." I said, "What do you mean?" Norm said, "Ken, tell me in the last three, four hundred, five hundred years what you think are one or two major developments in biology." I thought and I said, "Okay, Darwin's theory of evolution." He said, "That's perfect. Imagine Darwin writing and saying, 'I'm going to get on the *Beagle*…"

[laughter]

KH: I can't remember if it was him or somebody else that happened to say, "Mendel." "Oh, that's another great one. I'm going to plant sweet peas."

[laughter]

KH: He said, "Would those get funded?" The point is, that's not right. What happens as there's less and less money, people get more and more conservative so they want smaller steps but steps that they know are going to be successful. You're not going to have a paradigmatic shift if that's your paradigm. So that's what I wrote in this article.

HR: I asked you about some of the new things you're doing. You talked about creativity. Did you want to mention anything else?

KH: Creativity is one and I told you about the vertical stuff. There's lots more of that. I won't go into that more.

Another one is that we have the R21. It turns out that Schmahmann wrote about the cerebella emotional syndrome or something like that.

HR: Jeremy [D.] Schmahmann.

KH: Yes. It was descriptive.

I got called by [unclear] next door to see a patient whose family was falling apart, who had asymmetrical cerebella degeneration, worse on the left. I spoke to his wife. She said, "He doesn't care about the family or us or anything else." I started doing the same testing I did on that woman thirty-five years ago. The guy had no comprehension, no concept of faces, couldn't produce it, couldn't do anything else. It turns out that the left cerebellum goes to the right hemisphere. What I don't know, also, is whether this guy was really feeling emotion.

So we put this R21 where we were going to look at the cerebella, both strokes and in degenerative diseases and see what it does to emotional responsitivity. It makes sense from a phylogenetic point of view, because that's an ancient organ and emotions is a more primitive type of thing. That's another thing that we're doing research on, looking at that.

We, also, have, as I told you, three career development awards. One also has to do with prosody and faces in Parkinson's disease. They are tremendously devastated by that. They have problems both with comprehension and expression. So we're going to not only look to see…

HR: It's not just depression.

KH: We have some studies showing ways we can treat the prosody. Two things: we have them do repetition and, actually, also give verbal instructions, make it louder, make it blah, blah, blah. Both of them seemed to work well. This was with stroke patients that have been published. So we're going to try those things and the same thing with having them make emotional faces.

The other issue that comes up is about this whole thing with empathy. If they're not making a face, it's not because they're face is weak, it's because their motor neutrons are not doing it. So there's a whole concept about these mirror things. If they're not moving their face in response to somebody else's emotions, if they're not mirroring that, can they really develop that empathy?

I remember my son, when he was a little boy, when he was about a year and a half old. My wife was pregnant with my older daughter. He saw my wife vomiting. She had early

morning sickness. Guess what. He started vomiting. Pure empathy. With all my kids, when they saw anybody in the family be emotional, they got emotional.

Now, they're talking about that with autism, also, but with Parkinson's disease, what's happening with that? You know they're not activating those mirror neurons. So part of that, you see, is to look at their emotions to see what's going on and to see, even if we teach them, even though if it's artificial, if they make the face that goes along with the emotion, will they feel more emotion?

HR: Very interesting. I always resent people that say, "You should smile more. It will make you happier." [laughter]

KH: Maybe it does.

HR: Maybe it does, right.

KH: They are saying, "If you want to control your emotions, keep a stiff upper lip." Then, you can't express emotions. They're saying about the experience.

HR: It's so interesting about that mirror neurons.

KH: There's been some evidence about that, that expression does make a difference in people's…

HR: Certainly, the imaging of that in your own mind.

KH: I always give people this example…

HR: It's so interesting… If you see somebody start to almost chop somebody's hand off, you feel it. You feel it like you'd feel it if you were doing it, right"

KH: Oh, yes. That's exactly right.

[unclear] like in praxis. Not everybody does this, but if I say to some people, "When you're unscrewing a screw from the wall, do you move your hand in a clockwise or counterclockwise fashion?" Then, I say to those people, "Who said, 'Counterclockwise?'" and everybody raises their hand. And I say to them, "How many people…?" There is some kind of name – clockwise – I don't know what it is. Some people do see it, but the majority of the people say, "I don't move my hand, but I feel it in my brain going this way." You're actually moving your hand in your brain.

HR: Yes, you are. Right?

KH: Yes. So what happens is the motion…

HR: Imaging.

KH: Or imaging, but the motion has a cognitive element. That's also true with even emotions. So if you want to ask somebody how he feels, in a way to answer that, you almost have to mirror it. If those people can't mirror it, then…

HR: This is what it's like working with Doctor Heilman. We talk about a lot of things.

[laughter]

HR: It's very stimulating.

KH: So that's another thing, Adam Falchook is very interested in praxis and so forth.

It's part of being funded. I hadn't done this with a lot of fellows; I probably should have. I haven't done it at all, but I've talked about it. I need to probably write a book of the Machiavelli of funding.

[laughter]

KH: The Machiavelli of funding here was that the VA is very interested in head trauma. What's interesting is very few people have looked at that when you have head trauma, you have colossal injury. What happens with the hands because of colossal injury? Could it be that the left hand becomes a little bit apraxic and the right hand, because the left hemisphere is important for the intentional things, that this one becomes less kinetic and less persistent. That's what he's interested in doing.

Now, also, we're going to expand that and look at several other things. We're going to look at aging and intention. It turns out that when you look at people who get older—there's not been very much research—they become progressive couch potatoes. That's really, again, an intentional disorder. So what's going on with that and how can you treat it? Should we be giving Antidine to all the people so they have more getup and go? So he's into those kinds of things.

HR: The intentional system.

KH: That's right. The intentional motor system and different diseases in aging and Parkinson's and so forth.

The last one, John Williamson's career development award is with head trauma, again. But this time, what it's looking at is [unclear] who have head trauma have these Post Traumatic Stress Disorders and so forth. There's very little stuff looking at the control of the autonomic nervous system as a result of closed head trauma and how much there's a loss of control or not control. Again, this has to do with these feedback systems.

HR: People get this sort of big fluctuations in their temperature.

KH: Yes, [unclear] but the heart rate and all these autonomic things. If these are feeding back, how does that affect their emotional stuff and even the….

HR: Not even just in extremes but in the every day.

KH: …Post Traumatic Stress Disorder.

HR: Very interesting.

KH: So those are some of the things that currently are active, but it's not limited to that, as you know.

[laughter]

KH: Those are some of the things we're working on now.

HR: Great. I think that was a really nice window, the new things and not just reviewing some of the old things.

Let me transition a little bit into your role as a leader. This kind of goes as a leader and educator, but leader and, obviously, you mentor so many people in that sense. But I was thinking of a comment Kirk Daffner made at the Cognitive Behavioral Neurology Society Meeting that we have at the AAN, that satellite meeting where he said, "If Ken isn't here, it's just not the same." You're so much a part of the identity and the dynamic of the discussions that go on there. I'm also remembering your highlight session that you did with Adam Falchook. It was different than other highlight sessions. You looked at the papers and said, "This is what's interesting about this paper. This is stimulating. It kind of raises a question about this." Very different than highlight sessions, like they showed this and this was important. They showed this and this was important. I think in the discussions in the Cognitive Behavioral Neurology Society meeting, you're always one to stand up and say, "Look, this isn't new," or "We need to think about it this way." I'm always impressed with all you know. "What about area 37?" [laughter] The ability to be able to bring together your knowledge of the neuro anatomy, neuro physiology, the behavior in an open discussion kind of format…You're able to do that and I think it creates a model of what we all want to try to be and do and I hope we'll be able to continue doing.

How do you see yourself as a model or leader for people in that kind of role?

KH: Hmmmm.

HR: You started that for a very concrete purpose, right, for the development of the board questions. Do you think it's important to have that group be able to meet?

KH: No question.

Okay, let me come back and say that one of the things that I think we're losing… When I was a resident with Denny-Brown, he made us go to the ANA meetings—not made us but strongly encouraged.They held it in Atlantic City all the time back then in this crummy hotel. I can't remember the name of the hotel; I probably could look it up. But it was actually a really enjoyable meeting. What it is is everybody got in the same room. The papers they presented were almost like more controversial types of papers and people would get up. If you look at the old…

HR: Discussion.

KH: …especially the old *Transactions*, they actually had the discussions—I don't know if I have an old one—in the back. I have some in the other room. They have the discussions in the back. I think that is so valuable, because what it really is doing is raising questions, and interesting things, and so forth. At the behavioral paper sessions, they have an opening thing where they ask questions, but most of those questions are really about like technique or why don't you do a two-way t-test. It's not getting into more of the depth of things. The same thing is true at the ANA now, that that's no longer true. I think it's so important.

One of the things I loved about Norman is we would all sit there in the morning. I mentioned this earlier. He would say, "Tell me about some of the interesting patients that you saw." We'd all sit around and have these discussions. Even later on when we went to conferences and after we finished eating, we'd sit in the steam room or hot tub or something like that and we'd have these discussions.

I think that is so important for the creativity and understanding. I'd just love for that to keep on going. The meetings don't have that as much as they should have. Not only that but people really enjoy that. They like to think about stuff. We all went into neurology – almost all of us went into neurology for those things. My philosophy has always been, even as a kid, if I won the race, I won it because I run the fastest, not because I trip other people up. My thing has always been to listen and invite, invite, invite, invite excitement and invite interest, invite people to do these things. And I think in those meetings we do. We try and invite excitement. To go to a meeting, the didactic thing, you can read it.

HR: Well, some people don't have time to read.

KH: You understand what I'm saying.

HR: Yes.

KH: Then, they have all these things where they give hours for this and people go for the hours. I think it would be so nice to have a meeting to go to and you come back and you say, "This was a great meeting because I was stimulated." That's always been my idea. When I come back, I want to be stimulated.

HR: When you go for the posters, you can have some nice discussions with people.

KH: Yes, that is true. That's what's nice about the posters.

HR: Like I said, how you framed the highlights, this raises this interest in questions. It's very different than the way I've seen these highlight sessions done. That was nice.

I went to this aphasia meeting. Which one was it? The Annual Aphasia Conference…you had to be a member, but I was with somebody who was a member. One of the things I just enjoyed about it so much was the talks were lengthier. They had more time to speak. It may have been a half hour, some of them an hour. Then, the discussion period was twenty, twenty-five minutes. People would come up and ask a question. It didn't have to be short, sweet, and pointed. They could actually talk about what they were thinking about, I'm not really clear about this, ask a question, have a discussion.

KH: That's the ideal.

HR: Beautiful. Yes, it really was stimulating. It may be the size of the AAN and the way it's structured that it's harder to do that in those presentation session.

KH: Well, I don't know. If you come to the behavior sessions, the actual discussion sessions where people give it, there's still not a huge amount of people there.

HR: But it's five minutes to ask questions.

KH: Yes.

HR: It's ten minutes to present.

KH: I think sometimes that you want to get into really deeper thoughts and so forth. I think a lot of times, we go to these meetings to do what we're doing here. So I see people like you and we get a chance to talk about these things.

HR: I do come away stimulated, usually.

[laughter]

HR: I go to that meeting and I see you and I see other people who stimulate me.

KH: That's so important. That should be part of a meeting. That was one of the ideas of society meetings was to do that.

HR: Then, you find the people who are in your same area and you have a chance to talk to them about what they're doing. That is a good opportunity.

KH: That's right. Yes. As I said, Norman used to do that. He would be the main…

HR: Talker.

[laughter]

KH: One of the stories I love to tell is after one of these meetings, he was still trying to tell me something. Norman sometimes, when he got very excited, would get very, very close. I'm one of these people who likes to talk a little bit further away. I wasn't even presbyopic then. He kept on getting closer to me and talking. He was very excited about this. There was a Coke machine there and somebody had left their Coke on the top of the machine. They hadn't drunk it all. I leaned against the machine and the Coke tipped out of the cup. It didn't pour straight, but it got on top and started dripping off and it was hitting me. So I'm trying to move away and Norman is *so* focused. He says, "*Wait*! I'm not finished! I'm not finished!"

[laughter]

KH: So here's this Coca-cola dripping and he wouldn't let me go. "Ken, wait a minute. I'm not done!"

[laughter]

HR: I think they were thinking of having a little mini meeting at the Cognitive Neuroscience Society with neurologists there.

KH: I never went to one of those meetings.

HR: I haven't gone to one of them either. I was curious about that. One of the reasons I go to the AAN is because I feel like I can see the people in this field who are interested in patients and cognition.

KH: I agree with that.

HR: People go to specialty meetings much more now. In our field, I think the specialty meetings are not about patients, so it doesn't have that intersection as much.

KH: One of the things, again, when we were talking about this concern, I talked about the different layers, the tiers.

HR: The cake, behavioral neurology being a basic science that crosses over to [unclear].

KH: That's exactly right. So, for example, if you look at most of the sessions, they break it up to diseases, so there's multiple sclerosis. There's ALS. There's stroke. There is Parkinson's disease. I'm saying, "Wait a minute. As a behavioral neurologist, I want to know about all of these things." As we said, we're not disease specific.

Now, it turns out more and more they're pushing us to be disease specific into the dementias. For example, very few of the stroke fellows even rotate or are doing things with behavioral neurology. Look at strokes. What does it do? [chuckles]

HR: Exactly.

KH: After you get the mechanical part done, the tPA [tissue plasminogen activator] or whatever else, the big management part is you should be able to tell people, "This is the management."

Even the part of communicating with occupational and physical therapy, several times I've had patients with neglect and I put down, "Please, treat this person with prisms." They write up, "We don't have prisms. What would we use prisms for anyway?" I send them down the articles. They say, "We still don't have prisms." I'm going…wait a minute.

So the sad thing is we're not even educating the rehab people. Rehab is still being done by physiatrists. [John A.] Whyte, who is up at the Moss [Rehabilitation Hospital], he's really good. But most of the physiatry programs have very little…the amount of behavioral neurology training they have is miniscule.

HR: A neuro psychologist can do assessments, but medical people don't.

KH: We've been talking about other domains that we should be involved with. The rehabilitation domain should be really, really important. What are some of the ways you can rehabilitate aphasia? Almost every person who comes in to see, let's say, an aphasiologist, they have a standard therapy that they've learned independent of what the patient's problems are.

HR: You mean a speech pathologist.

KH: I mean a speech pathologist. So it doesn't make a difference what their problem is, they'll give him whatever they've learned to do. There are so many different things.

So, for example, the idea of Leslie and us wrote a paper about people with Alzheimer's disease. We didn't just do it with the people with logopenic [progressive aphasia] with their naming. It turns out that most speech pathologists when they train these people to name, they'll show them the picture and say, "What is this called?" The person will say, "That's…uh…that's the animal…uh, uh…it's a hippopotamus." They say, "No, it's a rhinoceros."

HR: Oops.

[chuckles]

KH: Then they say, "What animal is this?" "That's a tiger." They'll say, "No, that's a lion."

HR: Mistake learning.

KH: You got it. How did you know?

HR: I trained here. [chuckles]

KH: What they're doing is the classical Hebbian thing. They're making the incorrect relationships. So what they should be doing is saying, "See this animal? This is a rhinoceros. Say rhinoceros," and then *slowly* withdraw the thing. Now, I'm not saying, you may not want to do that with all the people, but you should have a repertoire of different forms of therapy depending upon the individual and what their deficits are.

HR: Historically—maybe you can comment on this—behavioral neurology was very involved with aphasia at one time. There was the American Academy of Aphasia. I think many of behavioral neurologists at that time were members of that. It seems like now it's not as strong an association with neurology and aphasia.

KH: I'm sure Norman was there and a lot of other people were.

HR: Speech pathologists have done great work and continue to meet and they have aphasia conferences. But those bridges like you're talking about between neurology and…seem to have separated more. I don't know if that has something to do with the fact that stroke has become much more treatment intensive and there's been less of a focus on the behavioral side.

KH: If you look at tPA, at almost every hospital, under five percent of the strokes are able to get tPA…less that five percent. A lot of them [unclear] strokes don't have type carotid stenosis. So I would think if you were a stroke physician that you ought to be giving some guidance to the rehabilitation people, whatever it is. So if you have somebody who has neglect, tell them about…

HR: Why not talk to the patient about what they have, too.

KH: And the patient and give them strategies and tell the other people, "This person has neglect. You may want to try…"

HR: They have anosagnosia.

KH: Have anosagnosia. In fact, it was interesting… I remember sending a patient down who had anosagnosia and they sent him back and said, "This patient is not interested in rehabilitation."

[laughter]

HR: I had exactly the same experience where [unclear] said, "We can't do this because they are not interested in…they lack awareness of this."

KH: That's the problem.

[laughter]

HR: Right. Those are interesting things.

We've talked about your research, your role as an educator. As you know, people really appreciate your lectures. They're dynamic. You've lectured at Harvard Medical School at the Behavioral Conference many years, I think on praxis.

KH: Yes.

HR: Always very well received. The comment you made about stimulating people's thinking, I think you also have that capacity.

KH: I try.

HR: Certainly, people find your lectures absolutely stimulating. Then, your mentorship of fellows has been tremendous.

KH: Thank you.

HR: You've always have a huge group of people here, not just neurologists but also neuropsychologists.

KH: And speech…

HR: And speech and not just neuropsychologists, but also neurologists. There are people in this field who will only work with specialized cognitive people from the Ph.D. side of things. But I think you've really been committed to training MD neurologists to be able to do this kind of research. [unclear] We've talked about your role as an educator. Do you want to make any more comments on that?

KH: As I said, that was part from the Norm Geschwind…I was there and saw how well those people worked together, Harold and Edith and Norman and Frank Benson, and how productive that was as far as doing things. I still feel that way, that there is a thing about bringing a team in who has different ways of looking at things and researching things and see how you can put it together.

HR: And not remain in silos.

KH: That's right. You know, in a symphony, somebody who is playing an oboe can do a very pretty job in the symphony, but when the whole orchestra plays, it's a little bit more fulfilling. The orchestra does need a conductor to be able to harmonize and put all these things together.

HR: I went and saw [sounds like Frank Hum-uh-lin] in Germany just before I came to do a fellowship here. He's a neurologist who is interested in behavioral neurology in Germany and was the head of a rehabilitation institute that I visited. Fascinating patients. They had a wonderful program with patients who kind of lived on the unit with different cognitive problems and they have whole programs. But what I was struck with is that he was the neurologist and, then, the other neurologists, it was look up how you treat atrial fibrillation in this case and give a lecture on hepatitis C, because people might be interested in that, but not at all engaging, actually, in the cognitive neurology of things. It was more the medical neurology [unclear]. I guess the medical conditions that contributed to the neurologic [unclear] from kind of the mechanic standpoint and not the behavioral. So there were neuropsychologists who did research. These things can be very separated.

I think one of the things that you've done here and what you said is coming from the Boston kind of model was working together.

KH: I think it's really important.

HR: I think at the University of Pennsylvania, now… I know Branch and Anjan are working with that group and maybe Hopkins, too, and Archie on those kinds of things.

Let me give you an opportunity to talk about people you think who are likeminded thinkers in your kind of field today.

You can even take a step back, say, when you started the Behavioral Neurology Society at the American Academy of Neurology, you mentioned Andy Kertez was there. Marty Albert was there. Who were the people that there at that time? Martha Denckla has appeared there.

KH: Martha was there and has been very, very supportive in the early parts. Francois Boller was there. He had trained, also, with Frank and Norman up in Boston. Al Rubens was there. Al kind of dropped out. He became chairman at Arizona, but Al was the first one to look at the cortical course and did some [unclear] with Frank Benson on the transcortical motor aphasias. So he was also part of that early group.

The second group that came in later on was people like Elliot Ross and [M.] Marcel Mesulam. They had been trained with Norman up there, also. That whole entire group of people were also very, very supportive. And people like Bob Watson, and Ed Valenstein, and so forth. All those people, as I said, were up there.

HR: I'm thinking about the likeminded people in your field, investigation. You had a strong connection with the International Neuropsychological Society [INS], so there had been some speech pathologists and, also, neuropsychologists.

KH: Leslie was even the president of it and she was a speech pathologist. Actually, the very beginning of the International Neuropsychology, before they had meetings, I think Norn Geschwind was one of the first presidents and so was Marcel Kinsbourne. Then, later on, it became very psychologist oriented. In fact, it was interesting because, later, on when I was elected president of it, there was a bunch of neuropsychologists that objected and said that they never got the ballots.

[chuckles]

KH: So they had a redo the election. It turns out that it was even stronger.

[laughter]

KH: There were some people who didn't like the MD neurologist.

What was interesting is that Edith—it was said in this book a little bit—and Harold, and other people who were up there, and Norman, had a really different take on neuropsychology than had been previously established. The main one was that the so-called Halstead-Reitan people learned to use their battery. Based on this, they would look at the scores and look up and say, "This is organic brain syndrome." Originally, it was used in the psychiatric hospital to look at who may have been neurological versus who was psychiatric. There was still a lot of that going on in neurology, even at the INS. So they saw neurologists being supportive of sort of the Edith Kaplan type. What Edith said is that it's just not the score of the test. It's watching people, how they do it, which is also important, and the type of errors they make. That gives you insight into the process. Of course, most of the people who were trained as behavioral neurologists came from—not all of them—the Norm Geschwind, Frank Benson school and really had that concept of neuropsychology. So there was a very strong, big division.

To show you about that and there have been a lot of conversions… We were the first people down here, even before the Academy did, to give a course in behavioral neurology and neuropsychology.

HR: This is the Florida meeting [unclear].

KH: Yes. It's almost like forty years or something like that. I think it's coming up on the fortieth year.

What happened is several people said, "You need to take this course and turn it into a textbook, because there is no textbook that treats neuropsychology and behavioral neurology that way." So we said, "Aww, who's going to buy it?" It turns out there was a Jeffrey [W.] House who was the editor at Oxford [University Press]. Arthur [L.] Benton

mentioned to him about this. So he [referring to Jeffrey House] contacted me and I said, "Do you think there may be interest in this?" He said, "Yes." So we got people… If you look at the first [unclear] chapters are by Frank Benson and…

HR: This has been a very successful book.[19] It's a mainstay, core textbook. In some ways, it's just as relevant for who we'd like to target as neurologists, but more often, it's read, I guess, by neuropsychologists.

KH: And even speech pathologists.

What happened was they published it and one of the journals had a review by Bob [Robert F.] Bornstein. He actually works for the INS and was the administrator. His review said, "First of all, I don't understand when two neurologists write a book that they call it *Clinical Neuropsychology*." He was a Halstead-Reitan… He goes on and says, "There's not even a big chapter about the Halstead-Reitan," going on and on about that.

He happens to say in his review that one of the chapters that he did enjoy was the chapter on neglect. So we were at some kind of party. It was really amazing; he comes up to me and he says, "Ken, what did you think about my review?" He was focusing on the neglect part [unclear].

HR: About how you didn't think it was appropriate.

[laughter]

KH: He said, for example they have a chapter about agnosia, "Why would anybody ever want to write a chapter about agnosia. It virtually doesn't exist." Well, in the Halstead-Reitan, they say it doesn't exist.

I said, "It was very kind of you to say nice things about the neglect. But why did you mention this other thing about the title, *Clinical Neuropsychology*?" He said, "Because you and Ed are neurologists." I said, "But we didn't select that title." He said, "Who did?" I said, "Arthur, come on over here."

[laughter]

KH: I said, "Arthur, you know that book we wrote? Who told us to call it *Clinical Neuropsychology*?" Arthur was a giant. He said, "I did."

[laughter]

KH: "Russ [Russell M.] Bauer, come over here." I don't know if Russ wrote the agnosia chapter. "Who wrote the agnosia chapter?" Blah, blah. That was the conversation.

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[19] Heilman K.M. and Valenstein E., editors. *Clinical Neuropsychology,* 5TH Edition (New York, Oxford University Press, 2012).

The next time when he wrote the next review, it was totally different. They were horrified because it wasn't classical neuropsychology using that one test. It was the processing. It was really Edith Kaplan's processing…

HR: Exactly. There's a difference. There's neuropsychological assessment where you use tools and you kind of measure the norms and you figure out… It's important. There are no psychologists who feel… As a professional, I don't know if it's territorial but you have to have your professional boundaries and these are our tasks. This is what we do. But having come from your program, I have this view of neuropsychology as having less boundaries and being more interested in the process and probing secondarily. This shows this but, let's see, what does this mean kind of thing?

KH: That's exactly right.

HR: There is a difference there in approach. It's not just the Halstead-Reitan story, but that's similar.

I remember when I interviewed Brenda Milner, she was described as one of the first neuropsychologists and I sort of asked her did she consider herself a neuropsychologist and what does that mean to her? She said, "Well, I don't really know." She considers herself a behavioral neuroscientist, we finally decided.

I've work with neuropsychologists in my community who are not of the ilk of probing and asking questions. So I think there is something in between kind of where the behavioral neurology intersects with neuropsychology. It's not just experimental neuropsychology, because it is about clinical assessment, as well.

KH: I think, again, we have this teeter-totter. Let me see if I can explain it. Yes, whenyou do a neurological examination, I think it is important to be comprehensive. You should look at the eyes, blah, blah, blah. On the other hand, you should never be confined by that. So there is a standard thing that you should do, but you need the flexibility if you see something that's abnormal to really focus in and pursue it. I think you have exactly the point that neuropsychologists, some of them, who are not just the Halstead-Reitans, so they'll give like an intelligence test and give this and give that. No matter what they find… For example, let's say they find that somebody has a naming problem. They give them the Boston Naming Test. Well, you know, they may not go there and look how is their comprehension of syntax? Can they repeat sentences? So go further out into that domain, what's going on in that domain. Yes, you need to do a complete exam. You need to look at all the major domains, but you also need to be process oriented and that's what we do. We do a neurological examination. If somebody comes in, I'll check their cranial nerves and I'll look at their fundi ??, but if I notice they have naming problems, guess what. They're going to be lots of other tests. I want to know if it's agnosia or is it an optic aphasia or it is this or is it that? What goes with it? Is there repetition? Can they repeat words? Can they repeat non-words, going on and on to understand what's going on with this system that's broken down.

HR: That process in neurology, particularly the hypothesis testing, as you're doing the examination, you're thinking about patterns, too, because certain patterns connect with certain diseases.

KH: Sure.

HR: Actually, this person, I need to check up-gaze and down-gaze. This person I definitely need to check other things, so you're thinking about things you need to check off, patterns, pattern recognition. Again, you want to probe something that you find and try to figure what the underlying deficit is.

KH: I agree.

HR: I remember giving talks to Russ Bauer's class on the neurological cognitive exam, explaining about that process. I think that is important.

Today, in neuropsychology, I hope that we can continue to work together in this way, as a sort of process neuropsychology kind of approach.

What did you want to call that book, by the way…*Clinical Neuropsychology*?

KH: What happened was Arthur told them about our course. I can't remember if he lectured in it, or something. He told Jeff House that there needs to be a book about this. When Jeff came to me, he said, "Arthur Benton thinks you need to write a book called *Clinical Neuropsychology*, which is like your course."

HR: Okay.

KH: It was already presented.

Arthur, to me, was such a wonderful human being. Did you ever meet him?

HR: No.

KH: Oh, gosh, he was one of the sweetest, nicest, kindest people.

HR: He did the JLO [Judgment of Line Orientation Test] work?

KH: He did the JLO and…

HR: Right hemisphere things and [unclear] a little bit.

KH: He did the [unclear], wrote a lot about history.

It's really interesting. Let me tell you a funny story going back to Brooklyn again. [laughter] One time, Norman and I were talking about something and he mentioned Buddy Hackett. He said, "Buddy Hackett used to tell this joke." He told the Buddy Hackett joke. He's an old comedian who has died. I said, "Wait a minute. How did you know Buddy Hackett?" He said, "Oh, Buddy Hackett lived in my neighborhood. We were friends." I said, "My brother was friends with Buddy Hackett. He lived on the block I grew up on." It turns out Norman Geschwind grew up about, I would say, four, five blocks from me. He and my brother, as it turns out, were different friends for different reasons. He wasn't an athlete and my brother loved sports, so he played ball with Buddy Hackett. But Buddy Hackett had more social things to do.

So we got to talking a little bit and it turns out Norman knew Edith way before they met professionally. I said, "How did you know Edith?" He said, "Well, Ken, where did your mother buy her bread and cake?" I said, "At a place called [sounds like Ev-in-ger's]." He said, "Do you know who owned it?" I said, "No." It was Edith's parents. [laughter]

HR: It all comes back to Brooklyn.

KH: It keeps on going. Wait a minute… I have to tell you a couple more stories about this.

This was at an INS meeting and we were talking about me discovering my dyslexia and this Spanish teacher kept on failing me. We were in one group and there was another group here. Martha Denckla turns around and said, "You're talking about Lena Grossman."

[laughter]

KH: "Martha! How the hell do you know it was Lena Grossman?" She said, "Because my mother worked in that school and we lived in that neighborhood. She [referring to Lena Grossman] taught in New Utrecht." Arthur's in the other group and he says, "Ken, I didn't know you went to New Utrecht." I always thought Arthur was born in Iowa City. He said, "I didn't know you went to New Utrecht. I went there, also!"

[laughter]

KH: So we're talking about this little area.

HR: There must have been something about that Spanish teacher.

KH: It was this little area, you know. It keeps on going.

It was funny because Martha, later on, told me that she told her father, who was a physician, about Lena Grossman and me. She said, "My dad was taking care of Lena Grossman and I told my dad this story." I said, "You shouldn't have done that. It's his

patient." She said, "Are you kidding? He can't stand her. He keeps on saying, 'Lena, why don't you find another internist?'"

[laughter]

KH: It goes even further. One time, Dave [David A.] Drachman is talking to me and I'm going, this is a déjà vu. Where have I heard people talk like this? Holy shit. It's Drachman. He was my English teacher in high school. Guess what.

HR: His dad?

KH: Yes it was Drachman's dad. They were there, also.

BWS: They [David and Daniel Drachman] were from Brooklyn, too, from that area?"

KH: Yes.

BWS: My goodness.

KH: Dan [Daniel B.] Drachman, I didn't know, but David was another behavioral neurologist. I have a picture of him and his father in the yearbook. You know how they talk; his father was exactly like that.

[chuckles]

KH: So here all these people from the same area. It was funny.

[break in the interview]

HR: I want you to be a little immodest. This is just a question that I'd like to see what your opinion is on in terms of how do you think and why do you think you're successful in research and investigation. What do you think your particular approach is to thinking that's made you successful?

KH: Mmmm… [pause]

HR: Everyone is different. You can be successful because you take a different approach and have sort of a-priori hypotheses of huge systems that you're testing, but what would you say characterizes your approach and you're particularly apt and well-designed…

KH: I think there are several factors. Again, it's hard to really go inside. Again, this tremendous joy from discovery, this excitement about discovery, which I think has been a very reinforcing thing. People now say to me, "Oh, you know you're seventy-five years old. Are you going to retire?" I say, "Why should I retire?" They say, "Then, you can do the things you always wanted to do."

HR: [chuckles]

KH: Guess what!

[laughter]

KH: This is something that I think I always wanted to do. So I've always gotten tremendous joy from that, it's interesting – a greater joy from that than if I won a huge amount of money in the lottery or whatever else…the idea of discovery.

My mother told me when I was a little boy that a clock broke that she had. I asked if I can take it apart to see how it works. This was below the age of five—maybe I was five or four. She said, "Yes, go ahead." I opened it up and she said that the first thing I noticed was that one of the gears came out partly. I looked at all the gears and I just pushed it back down again and it started working. [chuckles] But she said even as a little boy, I always wanted to know how things worked.

Bob Watson says that if he's forgiving enough and I finally get up to the gates and Saint Peter says, "Do you have any questions?" that I'll want to say, "Can you tell me about how the brain works with this part?"

[laughter]

KH: Two things. One is the joy of discovery and I think the other thing is curiosity, which is really important. I've always been a very, very curious person. I think that's been important.

Bob Watson and I were talking at one time about medical admissions. We don't know how to do this. We were saying that most of these tests, like the MCATs [Medical College Admission Test] and so forth, they're really testing knowledge and intelligence, whatever that means. But huge amounts of success have to do with persistence. I remember years ago, when I was a boy, somebody telling me a story about the *Talmud*, this book that Jews use—I didn't read it, but he told me this story—that if you're a rabbi, in Hebrew, it doesn't mean a preacher or something, it means teacher. The student comes to you and says, "I want to study with you," they're supposed to say, "No, I don't want you." If he comes back the second time, you say, "No, I don't want you." If the student comes back the third time, you have to take him. It's a frontal lobe test in persistence. I think another thing is really the importance about persistence. One of the first grants we put in about the neglect that I told you about, I have this thing also someplace in my archives here. The end of it says—this was when we were looking about the attention versus the intention with monkeys—"If these investigators ever find anything that's publishable, it would have to be serendipitous." Bob Watson was devastated! I said, "Now, we're going to go on. We're going to push on. We're going to push on." So, later on, we talked about this idea even with medicine, how important…to be successful, you need persistence. Think about it. How do you test for persistence on the MCATs or anything else? You can't really do it. It turns out grades alone could tell about that. But

if somebody who is so smart, they can get those high grades even without persistence. When you think about success, persistence is very, very important. And as you know, I've been persistent.

[laughter]

KH: Very, very persistent, almost a bother persistent.

HR: No, not at all.

KH: I think the curiosity, the thrill with discovery, the persistence.

Another thing that I think, again about myself—I don't know how to say this—getting even fellows like you, this thing of inviting people to join me, and let's run together, do this together. I think that's another thing that's been very important. For you to be successful, you really need… You need an orchestra to play a symphony. You can't do it with just the oboe. I think that I realized that from an early age and have done that. So I would say those are the major things.

The other thing is philosophical. I think throughout life…I have some depression sometimes. During the time you're depressed, you kind of ask yourself, "What is this all about? What's it all about?" I think the reason why I love medicine is… I say, if it's about anything, one of the things I can do with my life is try to reduce suffering. Medicine does that. That itself has been almost like my psychotherapy, in a sense—that and sports.

[laughter]

KH: In some sense of being able to say, "Look, if there's any meaning to life…" Not being religious, I don't have the concepts of "Well, it's all going to happen after I'm dead." Sometimes, you really have to wonder about what's the meaning of this all. I think when you do something like medicine, there is meaning, because you're reducing suffering both clinically and educationally and with research. I think that's been a very motivating factor also. I'm sorry, it's kind of preachy.

HR: Those are great answers.

I'm still going to probe one more thing. How do you think your style of approaching problems is different than maybe other investigators or researchers, say even in your field? Would you say you have a particular thinking style about attacking a problem?

KH: Mmmm…

HR: Cognitive style?

KH: There are so many different things about style. Like we talked about, I'm always looking for the whispers of nature. What can this tell me? When something is unusual, I don't want to throw it out and dispense with it. I want to say, "What's going on?" But that's part of curiosity stuff. That's a really hard thing to answer about research, about style. I don't know. I really don't know. I have trouble answering that.

HR: That's fine.

Now, these are some sort of more general questions, less personal. Do you have a few comments you want to make about how neurology has changed and you have a perspective over the course of your life and field for forty-some years? How have you seen the field change and what do you think the big changes have been?

KH: There are several things. One of the major things, as I talked about, people tried to persuade me not to go into neurology because there were so few things that could be treated. We don't have a lot of cures, but there are very few diseases that we can't treat now. It wasn't until my residency that they actually came out with L-dopa, levodopa, so we could treat Parkinson's. We gave them anticholinergics, which was almost hopeless. So we really had nothing there. Multiple sclerosis, there was nothing. Basically, the only thing we had was the same thing as internal medicine had. We had antibiotics for meningococcus and we had [unclear B2?] deficiency and hypothyroidism. But, now, as I said, there are very few diseases that are not treatable. They're not curable, but treatable. So I think that's a positive change.

One of the most dramatic things… I remember Ed Valenstein mentioning this to me. He was down here and went to a course on radiology, where they were supposed to talk arteriograms and pneumoencephalograms. He said that these people came out and they showed him pictures of a thing called a CT. He said, "It almost looked like a pneumoencephalogram." Back then, it wasn't like it is now. I'm going, my goodness. I think radiology, imaging, has had a tremendous influence and will continue to have an influence on us. I think that's been a very dramatic change.

I think there are problems with neurology and it makes me worry. That is, when I first came down here, as I think I mentioned, if I showed you the different residents, like Bob Watson was first in the class, and I can go down… We would have all these people who were in the very top of their class. The reason why they loved neurology is because it's challenging and reasoning and so forth. But, there were other things they could do what they loved and they could live a comfortable life. Back then, we were doing direct stick angiograms. We talked a little bit about this last night. So we were doing the carotid angiograms, direct stick. We were doing pneumoencephalograms. We were doing spinal taps. We were doing myelograms, plus EMG nerve conductions, and EEGs. That was a huge amount of procedures. Back then, in internal medicine, the only thing they had is they had EKGs [electrocardiogram] and they had sigmoidoscopes. I'm serious. That was it. So, because we had all these procedures and they always paid well for procedures, neurologists made a very comfortable living. You could even do academics and still live comfortably.

Now, it turns out that every patient I have, I'll look at their imaging and I would say at least once a week, if not more often—you probably know the same thing—there is stuff that I see on the images that were never read, from everything you can imagine. I spend a lot of time looking at those. How much do I get paid for that and making the diagnosis based on that? Zero. How much do the radiologist who say, "Normal aging" make? I don't know what they make.

So we gave that up. Actually, it was Fred Plum who was on the committee who decided to turn it all over to radiology. The original paradigms for the CT scanning, even [Sir Godfrey] Hounsfield got the Nobel Prize for it, was done by a neurologist in [unclear]—I can't remember his name [William H. Oldendorf]—at that VA who really came up with all those diagrams. They couldn't do it because they didn't have big enough computers. Hounsfield was the one who just adjusted the computers so they could use his diagrams. Then, Fred Plum, who was head of the committee said, "No, this should be in the domain of radiologists. That should be able to read it, not neurologists." So I think we lost that. I think the imaging thing is going to be more and more important.

Neruologists now, we have this real cognitive speicialty. To do a good neurological examinations and get a history and everything else takes you a minimum of an hour. They are not reimbursing that at all. What's happened is that neurologists' income has been trickling down, down, down, down. The problem is that people's debt for going to medical school is going up, up, up, up. So, many of them when they tell me what their debt is, it's hundreds of thousands of dollars—I'm always amazed by this—by the time they finish college and medical school. So they can't go into neurology just for purely financial reasons.

We have really wonderful, brilliant residents. Our first-year residents, I don't think any of them are from America. We have four from China and maybe one from someplace else—maybe there's one American there. They're really smart and they're good. But it's a different group than the group like when I went in or when you went in and so forth. I think that's a huge change. I'm really worried about it because it may actually be the destruction of our specialty, really will, and the way we practice it. We really don't get paid for the cognitive elements that we put into it. I'm very, very worried about that. I know the American Academy has been great about this. It's something they put *tremendous* effort into, but it turns out they haven't been successful. It's still very, very dismal. So that makes me worry a tremendous amount.

I'm also worried about what's happening with NIH. I think it's absolutely *incredible* that our government, of all things… Again, this is a little bit philosophical. When you look at all the suffering of mankind, there's only one domain where we reduce suffering and that's in medicine. They're now still talking about genocides. I guess in Africa there is still genocide going on. There are still people are starving. All these things that have gone on for ages are still going on. One of the sad things is it's even politics that are involved so we get [unclear]. They were trying to get polio vaccines in Pakistan and they killed the people who were giving the vaccinations for polio. I remember when [Jonas]

Salk and [Albert] Sabin came out, because I had lots of friends who had polio. It was a devastating disease. So you look at these miracles. There's no more smallpox. Polio could be gone. I can go on and on and on. The only place that you see a tremendous amount of progress in humanity, it turns out, is medicine. A huge part of that is research. Here's our government, if anything, what are they cutting down on? Down and down is research. When you're funding things at the ten, twelve percentile… In fact, that letter I told you about, they asked me to cut it down. What I did was I took how much time it takes a clinician, a physician to write a grant…you know, three months…and what their pay would be during those three months and, then, what the probability is of them getting funded. I said, "They'd be much smarter if they worked those three months, put the money in their pocket, went out to Los Angeles, went to the roulette table…

[chuckles]

KH: I'm serious… Put that money donw. I think they'll maybe take out some of that, not all of it, but some of that stuff. So I'm very worried about what's going to happen with neurology research, what's going on with neurology research.

The other thing is some of this is really driven, also, by the drug companies. Getting back to that Hauser article, it turns out they had these monoclonal antibodies to get rid of the amyloid and all the different monoclonal antibodies. In every one of the studies, even the people with mild Alzheimer's, they gave it to them. It didn't really change…maybe a little bit, just minicule they changed their course. So what does NIH doing now? They're saying, "It wasn't early enough." Now, what they're going to do is give it to people just based on amyloid scans or people who have this or genetic stuff. Again, they're pushing NIH. If you look at Petersen's article in the *New England Journal of Medicine*, that was supported by NIH. They were giving [sounds like Den-az-uh-pil – Danazol?], which was a drug company, because, again, they had linked up with that because of the academic push. They even have all these Alzheimer's centers. How long have they been funding them? You show me any of those things that have made any kind of paradigmatic shift. None of them.

I still think the best way is to look at somebody when they have a really brilliant idea, a very creative idea, and put the money in that type of creativity, give them money for preliminary studies and, then, do that. But it's turned all the way around the other way and I think it's really inhibiting our research and that makes me scared about neurology and other fields in medicine, also. That makes me very, very worried.

All those things are concerns about the future. But, on the other hand, I think from the point of view of neurology, as the population ages, there is *no* question that there is going to be a greater and greater demand for neurology. Unlike certain fields, if you take a field like cardiology, when I was a resident in medicine, there were two major things: atherosclerotic disease or rheumatic heart disease. Rheumatic heart disease is almost all gone now. So the main thing is atherosclerotic disease. So if turns out that earlier starting of statins and ace inhibitors really prevents it, that specialty may be like syphilology, it may be gone. I'm dead serious about that.

It turns out that neurology, when you look at our field, instead of shrinking into one disease, if anything it's becoming greater and greater and greater. Now, some people put everything in the same pocket, so you'll have people with posterior cortical degeneration, people with memory loss, another cognitive thing. You'll have people with corticobasal degeneration. They all can have the Alzheimer's disease but, guess what, it turns out, yes, they have that pathology, but I'll bet you those are different diseases. So we're going to see more and more, as people age and so forth, a lot of different diseases. I think there is no end to this. The brain is the most complex organ, so more and more, no matter how much we try and study it, the more we learn about it, the more we're going to have to learn. I don't see any end to it. In fact, I think it's going to be more and more exciting as time goes on. So I don't see any end to it. I'm just worried about the external forces, as I said, government and payment and so forth.

HR: That's excellent.

That touches upon this next question I have. I was asking about neurology and sort of the changes in neurology. Do you want to make any comments specifically about academic neurology? You covered that sort of in that question, I think.

KH: Academic neurology scares me, also. Here at our university, our vice president of Health Affairs [David S. Guzick] is discouraging departments—when I heard this, I could almost not believe my ears—telling young people to go for K Awards, because, it turns out, they lose money…

HR: Yes, yes. I've had that same experience.

KH: Okay. To me, when I'm hearing that, I'm going, you talk about killing your offspring…

[chuckles]

KH: I'm sorry. That sounds kind of…

HR: It's an apt metaphor.

KH: So I think it's like killing your offspring. The younger people, rather than encouraging them to be the academicians that I knew… Back in the old days, the academicians wore three hats. They were researchers. They were educators. And they were clinicians. I think those three hats made all these quantum leaps. But now, more and more, they're asking people just to be clinicians, just do the RV [right ventricle] unit, blah, blah, blah. They only give people now tenure track if they have two RO1s in this place or something like that. How do you even get to that point if you've never had a K Award, because you don't get an RO1 unless you showed other things? I think they're doing this because they're getting squeezed. But if there was ever an example of

procrustean thinking, this is procrustean thinking. The bed is too short, so we're going to cut off your legs.

[chuckles]

KH: So, it scares me.

HR: Where do you think that economic pressure is coming from in academic medicine? Why do you think that's changed?

KH: It's interesting. When I went to medical school at U-VA, we had Dean [Thomas H.] Hunter, a really good man. This was when Medicare was first coming out. I was really for the idea of Medicare saying, "We need to take care of people." I had a good friend who was very, very progressive, very, very smart. He said, "When the government pays you, the government is going to control you." Who was right and who was wrong? I was wrong. He is right. They are controlling us. What's fascinating is…

HR: What do you think about the role of private insurance?

KH: Let me just come back to this in a second. Let me continue for a second. It was interesting that the American car industry, which was so far ahead for so many years of anything in the world, had people just do little things. You put this bolt on here and you do this. We're interested in how you do but we're not interested in your ideas about how to make it better. Just do this. It actually turns out that the Japanese are a much more obedient society than we are. They were actually getting input from their technical people and Toyota and those cars were improving. Our cars were going downhill and downhill and downhill.

I think that's exactly what's happened in medicine. We're doing what those car manufacturers did in the 1960s. We're saying, "You're just going to read these EEGs." "You're just going to take care of the people here in intensive care." "You're just going to do this." "No research. Just do that." I think that is a program for devastating what we know about and how we do it. The government likes that, because they understand that kind of piecework.

When I came here, I didn't have any grants. Mel [Melvin] Greer said—it was just him and me—"You're going to be on the wards and cover the clinics and everything." I covered the clinics even when I wasn't on. They were two days a week. "The other time is your research," two half days a week, but there were more than that. Those half days, they were days.

[laughter]

KH: "The rest of the time is going to be you research time." This is without grants. And "Let me know how I can help you. What do you need?" Show me who comes into medicine now where they have that kind of mentality of saying, "Look, I want you to be

successful. Tell me what I can do to help your success." You don't see that anymore. Without that, if I didn't have that, what Mel Greer did, that's how I was able to get all the stuff started. I think that's a really, really important thing.

I think insurance companies together with the government—the insurance companies are acting like the government—what they're trying to do is make physicians and academic centers no different than those assembly line plant workers. They're moving us. We will be assembly line plant workers if it continues in the same way. I think that is going to devastate medicine. It's tragic. We really need a lot of voices that will speak up and say, "Take your head out of the sand. This is really devastating."

Do you disagree with any of this?

HR: No. What do you see as the solution? Even since I've been in the field, there's been a big change in the pressures to see patients faster and the measurement of RVUs has become much more…and [unclear] a little bit arbitrary. One year, it's a certain thing, you're doing the same thing, and the next year, they've changed, and you're doing the exact same thing. Certainly, procedures historically, we're [unclear] RVUs per time. We could go on and on. Inpatient gets more RVUs relative to outpatient but it gets less receipts. It seems that departments are run where they're very focused on how much you're bringing in. You can have different models within an academic institution to try to counterbalance that by ensuring that people get academic rewards and are supported. But it's still a very stressful environment and the pressure is all from this clinical academic side. My impression has been that's it's been driven by the economics of insurance companies, like you've been mentioning. There used to be a few of them. There are more of them.

KH: And the government.

HR: And the government, possibly, also. I don't know if it would be different [unclear] system and there was a little [unclear]. Who knows?

KH: I think if it was one system that may be more repressive. I don't know.

HR: It's hard to know. These are big questions. Big solutions. I lived in Germany. Things worked pretty well with the [unclear] system there. In Canada, the academic people I talk to—I don't know that system really well—do very well in academic medicine there as neurologists doing procedures and very, very well compensated by, I guess, the government. There are different systems from the educational standpoint there, too, and that may alter funding structure. It's hard to know where we're going to head from here.

What do you think the solutions would be right now? If you were speaking to some department chair right now, what should they do in their own departments?

KH: I'm going to tell you a story. When I was at Bellevue when I first started my internship—I wasn't part of this, this happened the year before—the year before actually interns were not paid. In fact, even several years before that, they actually had to pay for an internship. They weren't paid.

[chuckles]

KH: Here are these guys working some services thirty-six out of forty-eight [hours], or whatever and they weren't getting paid.

So what happened in New York City, they got the three major hospitals, Kings County, Bellevue, and Einstein, is they asked the house officers to try to find the ones who had the most kids at home. Then, they had them put on their white coats with the caduceus, and with their wife and their kids and go to the same welfare place so they could sign up for welfare. Of course, they called up all the newspapers and said, "You ought to go down to the welfare office. There's something that you have to see." So there they were. I don't know who was mayor—was it Lindsay? I don't remember who was mayor—got something like 50,000 written letters in one day after this was in the *New York Times*. Then, they started to give us money, seventy-five dollars a month.

[laughter]

KH: This is really true.

So I think—we haven't been doing this and I don't know who is to do it—there's a public that has to be made aware, really be made aware, that the current insurance and governmental policies are really devastating to medicine and the progression of medicine.

I didn't say a lot about this, but I put another grant in. I'm not sure I want it funded. I don't think I have enough time. [chuckles] What this grant is is that it's attempting to look at maybe what the early signs of the people that you will predict with myocopia impairment who will go into Alzheimer's.

For example, I told you about the smell test with peanut butter. These are people who have Alzheimer's, that their left nostril was decreased compared to their right. We have about—I'm making these numbers up—eight people who have mild cognitive impairment who also had that and some people with mild cognitive impairment who didn't have it. Now, it would be good to follow along to see if that predicted… We have other tests like that. That's not the only one. So we put this in and I got a letter a couple days ago saying, "Because of the government delay, this is not going to be reviewed for another six months," or whatever it is.

Now, does the pubic know? Has the public been made aware? There are a lot of medicines, whatever it might be, that are being delayed because of that. Do the people know that people if put in these grants that have a tremendous potential to help people that they're not going to get funded because there's only ten percent of them that are

going to be funded? There really hasn't been enough publicity about that and people telling about that and really explaining that to people. I think politicians, the only thing they want to know and want to do is get elected. If people know that they're not supporting the system and you say your representative has really devastated NIH and devastated healthcare, and you want to vote for him, and keep him in, that's fine. But if you get a disease and suffer with it, realize that it may be his fault and you point your fingers…" Again, let people know about it. It hasn't been done. It has not been done. They spend all that money; they go up to Washington and they go and speak to their representatives, but they're trying to convince them rather than… That's not what they respond to. They respond to one thing: whether they're going to get reelected.

HR: There was a little publicity that came out with the government shut down that I thought was interesting of people being turned away from NIH trials, at that time, or certain kinds of medicine wasn't being done. I thought that was something that really did have some traction.

KH: Yes.

HR: But at the same time, what you're saying, it's not just the government shut down, it's that all these things that could have been done for people are being de-prioritized.

KH: Yes.

HR: There's always this mantra about how much money is spent on healthcare. You can discuss that, but healthcare is a priority. Being healthy is one of the things where the nation should be placing its priority. People need to understand, also, what it does for people.

KH: Oh, sure. They need to show how things like polio looked before they did the research.

Even more than that, it's kind of interesting that even with the Obamacare…[20] What's really fascinating is how they kind of approach it. The real question comes up… Patricia [Doctor Heilman's wife] asked me a question, "If Hillary Clinton runs on the Democratic side, would you vote for her?" I said, "I don't know. I have problems." She said, "Why do you have problems?" It turns out that I was on a committee for the AAN. What happened was when her husband [President Bill Clinton] was looking to do healthcare, she got a group of people to advise her. She didn't want any physicians on that committee, because they were all moneygrubbers.

HR: Ohhh. [chuckles] You're not going to forget that one.

KH: What happened is a vote came up about inviting her, I think it was, to one of the meetings. I was unaware of this. We got these letters in from all these neurologists saying, "Having her go in there would be one of the greatest insults…to organize this."

[20] Affordable Care Act.

HR: I think there's an economic kind of academic healthcare [unclear]. There's a lot of blaming the physicians for the price of medicine—and there is some of that going on in certain sectors. One of my favorite people in [unclear] writes about psychosocial stuff in medicine, you know this expose in Texas of these people who had some racket where they would just refer to themselves [unclear] whole bunch of money. I saw them on NPR [National Public Radio] speak about this, as sort of this is the problem. I thought, oh, my goodness. It's such a disservice to paint it in these [unclear] terms. I thought this is why people get confused about this. It's more complex. It's not about physicians getting more and more money.

KH: No. I'm not saying that.

Getting back to the Obamacare thing…

HR: It's funding priorities.

KH: But, I was going to say if I was on some committee and people were going to ask me about government and medicine, what I would do is say, "You know, I think what ought to start is a progressive triage system." They'll say, "What do you mean by that?" I'd say, "Look, if somebody has a heart attack or stroke who doesn't have insurance, it costs the hospital in the community $100,000. It's probably close to that or maybe more. So if somebody has high cholesterol and they can't afford a statin, it would be worth it for the government to help them pay for that statin.

[chuckles]

KH: The same thing with blood pressure. What you would do is you would prioritize things and say, "What are some of the most expensive things we have?" and, first, make sure everybody does preventative things. Am I making sense?

HR: Yes.

KH: The first thing in government intervention would be if you're going to intervene as the government, it should be for prophylaxis. That will actually end up saving you money rather than the opposite. That's true of almost every domain of medicine, whether it be the eyes, having somebody check to see if they have glaucoma. I can go on and on. Make sure women don't have breast cancer. Make sure that people don't have blood in their stools. I'm just saying, "Look at all those things that we know are preventions, and if people can't afford that, that's the first thing you help with, because if you do that, you'll end up saving the government money." No one talks about stuff like that. They don't ask for physicians' advice about stuff like that. They just make theses things and blah, blah, blah. It doesn't make a lot of sense. That's not something I want to cure.

[laughter]

KH: And I don't want to run for office. I don't have a lot of politician in me.

HR: Let me get just a couple last questions in. Do you want to say something about the AAN, the American Academy of Neurology?

KH: Yes, I will. The American Academy of Neurology…I don't think there is any question that it has been one of the most profound and strongest influences in advancing neurology. They've done a *wonderful*, wonderful job. The testimony to that is when I go to the meetings, its how many people I see come from France and Italy and other nations, because this is the epitome of all meetings as far as papers, and presentations, and so forth. I think almost in every domain, it's trying to advance research, advance education – they've done a wonderful job. All the people I've met up there in Minneapolis, Christine [E. Phelps] and all these other people running the meeting. The meeting was absolutely wonderful. Now, there are little things, if you'd ask me how to change this and that. I don't have any question really that the meeting has advanced neurology a tremendous amount.

Even the original idea of opening it up to everybody at some level…[unclear] people. You want this thing to be an educational institution, which it is. *The Journal of Neurology* has always been one of my favorite journals. It's always been very clinically oriented; whereas, *Annals* has been very research oriented. Now, when I say clinical, I'm saying the clinician and the researcher, both get something out of *Neurology*, so I think it's been a wonderful journal. Throughout the years, the leadership, the presidents and everything, even that was brilliant. One year, they'll have an academician and one year, they'll have a practitioner. So, again, what they're always attempting to do is to invite people in. Medicine, even if you're a practitioner, you still always need education. You've got to always learn and you're always teaching both patients and other people. So I think that's been wonderful.

I think even their attempt to legislate on behalf of neurologists has been very, very important. As I said, I may do it in some other ways, but I think that they have the right intention.

Then more and more now what they're doing is looking to support research, and papers, and people coming to their meetings and hearing about this, so they have a whole bunch of fellowships. I'd love to see that even more and more in awards, like the Norm Geschwind Award.

So I have all positive feelings. I don't have absolutely any negative feelings, nothing negative about the Academy. I have, as I say, only strongly positive feelings.

HR: You mentioned you enjoy meeting people there you haven't seen for a while.

KH: Oh, it's a great place to meet people, and to have discussions, and to go see the posters and talk to people about their posters. They really encourage young investigators

to come there. I think that's a tremendous, rewarding experience to have your poster up and do those things.

As you know from my discussions, I can find fault with a lot of things, but not with the Academy. The Academy has really been great.

HR: Maybe a last question and, then, I'll let you mention anything else you'd like to mention. We're doing an archival interview about your life, and your contributions, and your perspectives on all the neurology. I want to give you an opportunity to kind of mention what you thought the most important legacies you have—you've touched on these things—in your roles in neurology as a teacher, as an educator, as a clinician that you've kind of given to the community. They have been a lot!

KH: You're a better judge of that than I am.

[chuckles]

HR: I can make up an answer.

KH: I think…

HR: It's a combination.

KH: …the idea of asking somebody a question what is the most important…

HR: Most important lega*cies*.

[laughter]

KH: Again, I think they're all very, very interactive. Just like we talked about, the clinical care and research have held hands and the educational things have held hands with the clinical and so forth.

You know, to be honest with you, I was telling Patricia—we were talking about you all coming—and I said to her, "I hope I can transfer the feeling that I've really been blessed in many ways." Now, if I can get my handicap down in golf a little bit…

[hearty laughter]

KH: I've really been blessed for many, many reasons. I was blessed to have wonderful teachers. I was blessed by chance to have the brain to be able to absorb what the teachers were teaching me. I've been blessed to have wonderful mentors like Norman, and Denny-Brown, and Mel Greer when I came here, and many other people are on that list. I've been blessed to have wonderful fellows like you, Heidi, and many, many other ones. I'm not going to mention all of them, but realize about almost all of them, I have the

same really positive feeling. I've been blessed to have unbelievably great co-workers all these years, like Ed Valenstein, and Bob Watson, and many, many other people.

And I've been blessed, again, to have a wonderful family. Patricia has been a wonderful wife. I spend huge amounts of time as a clinician, and investigator, and educator. I would spend time with the kids, but she brought up the family and has always been very independent and really allowed me to pursue these things, and that's been a great blessing, also.

I feel blessed, lastly, just to be alive and to be able to continue doing it now and I'll do it as long as I can.

[chuckles]

KH: So thank you so much.

HR: Thank you so much. This has been a wonderful interview. I think we have so much wonderful material.

KH: Thank you.

Barbara, is there anything you wanted to ask?

BWS: Is there anything you'd like to say to neurologists who are coming along? You've said some of this already. But is there any advice you'd like to pass along?

KH: Oh, there's so much. We'd be here for another four hours. Persist and discover.

BWS: Very good.

KH: Thank you so much.

HR: Thank you.

[End of the Interview]

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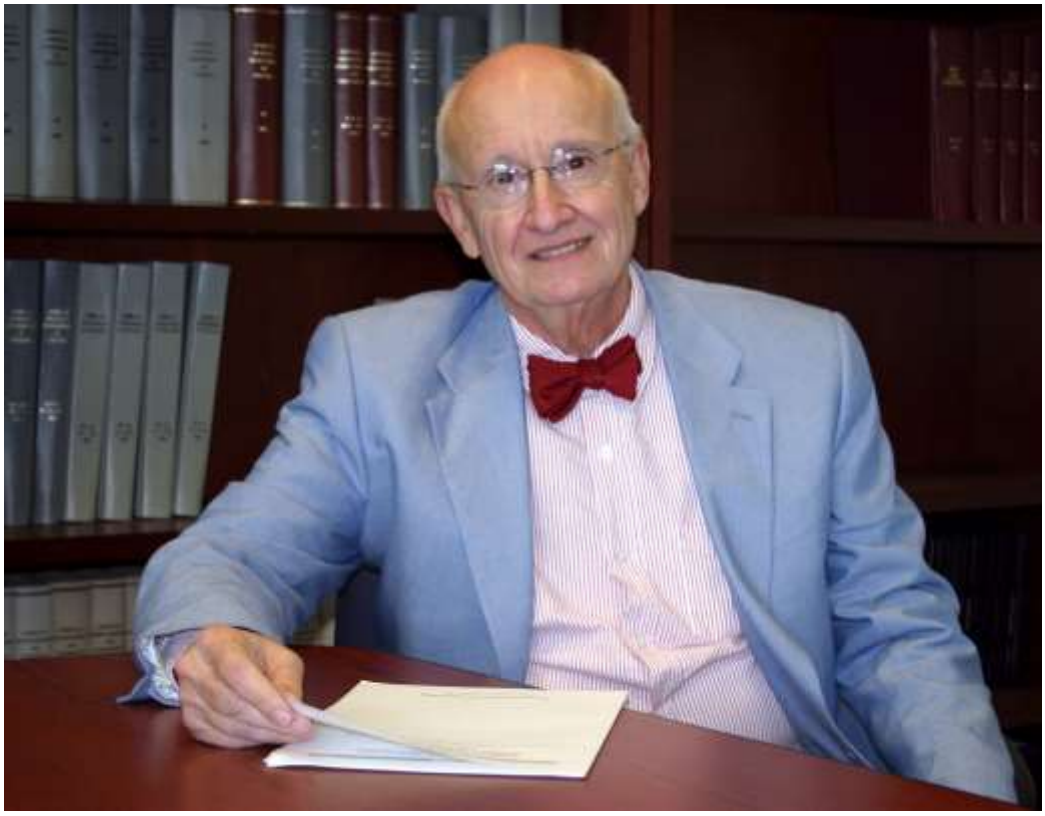

Dr. Kenneth Heilman in his office in the Department of Neurology, University of Florida Medical Center, Gainesville, Florida.

Dr. Heilman in the interview setting, November 4, 2013, University of Florida Medical Center, Gainesville, Florida