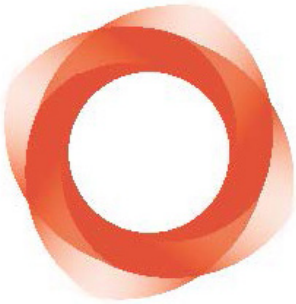

SYRACUSE UNIVERSITY
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Policy Brief

Biobehavioral Risk Factors in Coronary Heart Disease

Ilene C. Siegler, Ph.D., M.P.H
Duke University

April 19, 2016

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Introduction

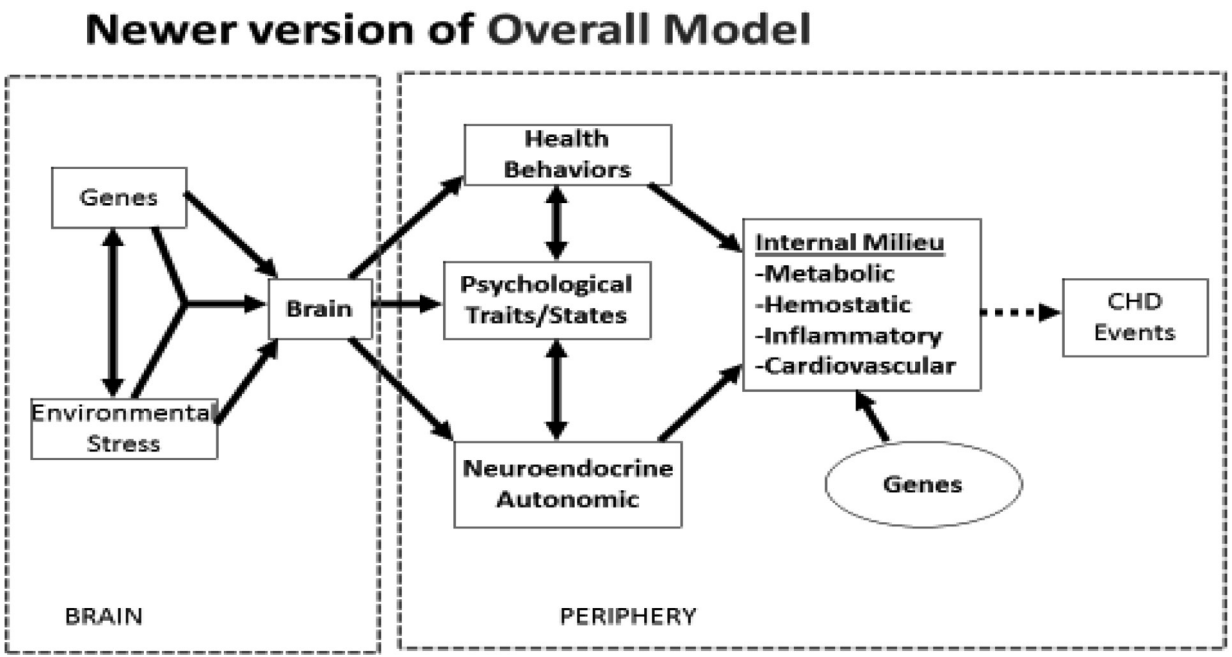
A lifespan perspective provides important insight into maintaining health in later life and data are now becoming available that allow us to evaluate the impact of early experiences on later-life outcomes (Power, Kuh, & Morton, 2013; Siegler & Ogle, in press). This work has implications for searching for the biological mechanisms that underlie behavior as well as implications for policies that can support individuals, families, and their clinicians, with the best knowledge available today with the goal of maintaining health in middle and later life. While maintenance of health is more than avoiding or postponing disease, the current state of the science is designed to target persons at high risk to reduce the burden of chronic disease in middle and later life (Williams, 2008; Williams, 2016). This brief will review the contributions of the UNC Alumni Heart Study, and its associated studies, to understanding later-life chronic disease processes.

The UNC Alumni Heart Study (UNCAHS) was designed to test the hypothesis that hostility does predict coronary heart disease in members of the Baby Boom Cohort who are now aged 70. It was

the prospective epidemiological component of our Program Project Grant (PPG) "Biobehavioral Factors in Coronary Heart Disease" in 1986. It was built on archival personality data from 1964-66 that, with the help of the General Alumni Association at the University of North Carolina at Chapel Hill, allowed us to have data at college entry as the main sampling frame for the study (see Siegler et al., 1992). Aside from the UNCAHS, the PPG was also the source of the MOSS – Mediators of Social Support Project (Barefoot et al., 2000; Bosworth et al., 1999a; Bosworth et al., 1999b; Bosworth et al., 2000; Siegler, Kaplan, Von Dras, & Mark, 1999; Von Dras et al., 1997; Von Dras, Siegler, Barefoot, Williams, & Mark, 2000; Williams et al., 1992;) which focused on cardiac patients who had their catheterization at Duke. The CATHGEN Study (CATHeterization Genetics, Kraus et al., 2015) is also part of our current PPG. In addition, we are continuing our work to study the role that race and gender play in study recruitment, as recruitment into laboratory study protocols such as those in the PPG also varies by race and class (Burroughs et al., 2003), as well as the interactions of family structure in the architecture of caregiving (Siegler, Brummett, Williams, Haney, & Dilworth-Anderson, 2010).

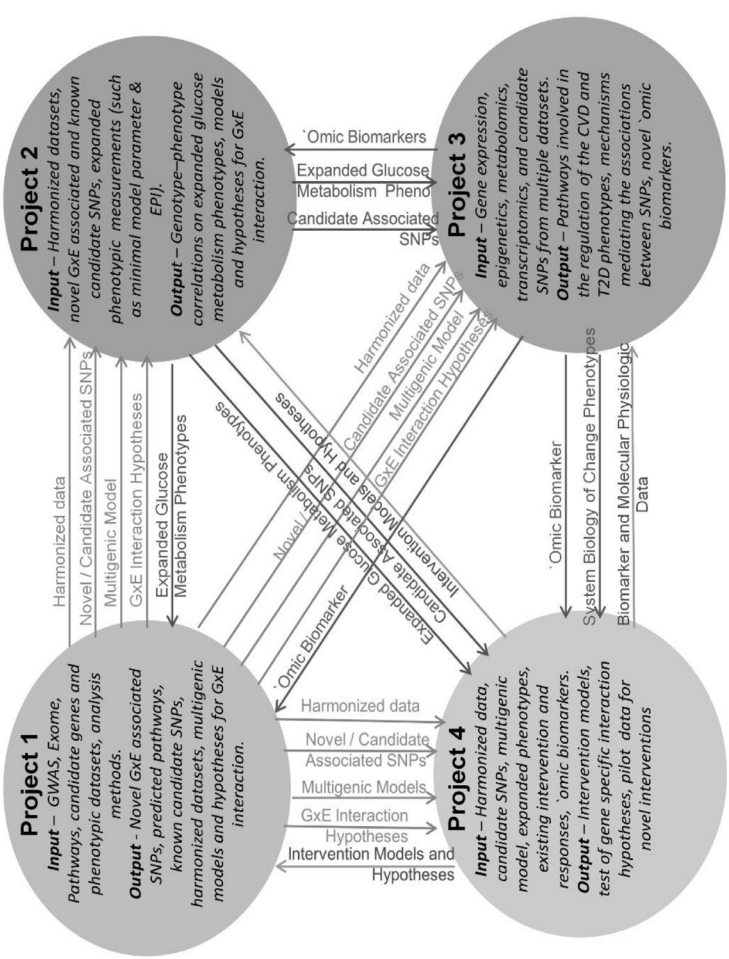
Both the UNCAHS and the PPG continue to the present day. The theoretical model guiding our work is shown in Figure 1a with the current operationalization of the PPG shown in Figure 1b. Understanding the implications of a genetic basis of

Figure 1a:



Williams, *Ann Rev of Clin Psychology 2008*

Figure 1b: Design of Current Program Project (2016-2021)



Created by Abanish Singh

coronary heart disease for aging is a major task for the future (Dungan, Hauser, Qin, & Kraus, 2013). Current implications are also important as coronary heart disease is a major health problem that can lead to decisions about work performance, the timing of retirement and possible age discrimination (see Edelman & Siegler, 1978). In the 30 years that these projects have been operational (1986-2016), the UNCAHS was supported within the PPG (1986-96) where it tested associations between psychological traits/states and health behaviors.

The Program Project brings together data collected in many other venues and functions as both an incubator of new ideas that allows our data to be combined with all of the data available nationally and internationally (Singh, Babyak, Brummett, et al., 2015; Haberstick et al., 2015), as well as a data repository for the previous work of all of the collaborating investigators.

Our work from the UNCAHS with the same behavioral risk factors for cancer can be seen in Siegler and Costa (1994), Siegler, Feaganes and Rimer (1995; 1996), and Bastian et al., 1997 which provided pilot data for our work on decision making and hormone replacement therapy (McBride et al., 2002). In this report, because of space limitations, I will focus on data from the UNCAHS and the PPG results on coronary heart disease and some of the work that led up to it (Siegler, 1983).

For example, our research with this data has yielded several findings regarding the role of life events. Our research on gender differences in life events (Siegler, 1982; Siegler & George, 1983) found that studying how individuals interpret life events is often different than researchers imagine or measure. For example, individuals reported that events that did not happen, such as never marrying or never having children, could have a greater impact on well-being than events measured in the traditional way (see e.g., Schlossberg & Robinson, 1996), and furthermore events that happen to others are also important.

Rubin and Siegler (2004) reported that personality was related to components of autobiographical memory. Rubin, Berntsen, & Bohni (2008) developed a memory-based model for understanding post-traumatic stress disorder diagnosis. Berntsen, Rubin, & Siegler (2011) studied positive and negative events across the lifespan. This collaboration has been the source of our work on post-traumatic stress disorder symptoms and coronary heart disease (Siegler & Ogle, in press; Siegler et al., 2016).

Personality Changes and Life Event Stress

The repeated measures of personality at different developmental stages in the UNCAHS, coupled with the study's assessment of several post-

traumatic stress disorder symptom risk factors, make the UNCAHS cohort uniquely suited for investigations of the processes through which personality influences vulnerability to post-traumatic stress. Our recent work in this area (Ogle, Siegler, Beckham, & Rubin, in press) indicates that neuroticism increases the risk of post-traumatic stress disorder symptoms by enhancing particular phenomenological properties of trauma memories that amplify the availability of the trauma memory in mind, including the intensity of physiological reactions to the memory and the frequency of involuntary rehearsal. Our initial findings revealed when particular types of traumatic events are likely to occur during the lifecourse, as well as which types of negative and traumatic life events are most likely to cause psychological distress, including post-traumatic stress disorder symptoms during older adulthood (Ogle, Rubin, Berntsen, & Siegler, 2013). Older adults who experienced traumatic events, 40 or more years ago in childhood, reported more severe post-traumatic stress disorder symptoms and lower psychosocial functioning compared to individuals who experienced relatively recent traumas in adulthood (Ogle, Rubin, & Siegler, 2013). Furthermore, individual difference measures assessed after the trauma, including insecure attachment and characteristics of the current trauma memory, better accounted for symptom severity than pre-trauma factors (Ogle, Rubin, & Siegler, 2016).

Life Event Stress and Coronary Heart Disease Risk

Studies on the relation between post-traumatic stress disorder measured by reports of symptoms and coronary heart disease in older adult community populations have been limited by self-reports of coronary heart disease and limitations in the timing of the events that are considered for the assessment of post-traumatic stress disorder. The assessment of post-traumatic stress disorder symptoms was added to the UNCAHS when the cohort was in their early 60s but evaluated the impact of event from the full life span. It was indexed as a score of greater than 44 on the Posttraumatic Stress Checklist (PCL-S). Coronary heart disease was confirmed by medical record review for heart attacks and revascularization coronary procedures. Logistic regression was used to test the association of post-traumatic stress disorder symptoms with coronary heart disease in sequential models with data from 1964-2011, controlling for established coronary heart disease risk indices. UNCAHS study members with post-traumatic stress symptoms sufficient for a diagnosis of post-traumatic stress disorder were about 2.5 times more likely to have coronary heart disease than their peers without the significant life event stress suggesting that post-traumatic stress disorder symptoms are an important source of multimorbidity for older persons and thus its treatment is a potential prevention strategy for subsequent coronary heart disease (Siegler et al., 2016).

Understanding Coronary Heart Disease Risk Factors and Their Interactions

Because we have repeated measures of traditional coronary heart disease risk and protective factors (Siegler, Peterson, Barefoot, & Williams, 1992; Siegler et al., 2003; Hooker, Hoppmann, & Siegler, 2010; Siegler & Davey, 2012), we focus on findings that take advantage of our study design. As shown in our model above, the health behaviors we have studied include smoking, excess weight, body shape, and sedentary behavior as risk factors; social support and exercise as protective factors; with alcohol consumption dose dependent in prediction of coronary heart disease, with higher risk at none and too much alcohol and lower risk at moderate amounts. Measures of psychological traits and states include primarily measures derived from the Minnesota Multiphasic Personality Inventory (MMPI; Dahlstrom, Welsh, & Dahlstrom, 1975) for measures in college and the NEO Personality Inventory (Costa & McCrae, 1992; Costa, Herbst, McCrae, & Siegler, 2000) for measures of personality during midlife. The NEO-PI or Five Factor Model (FFM) is a very flexible measure of personality that can be considered as five factors: neuroticism, extraversion, openness, agreeableness, and conscientiousness.

Siegler, Peterson, Barefoot, and Williams (1992) reported that hostility in college prospectively predicted hours of exercise reported at midlife,

controlling for age and sex, with higher hostility associated with more exercise. This relationship was surprising as hostility generally predicts risky rather than protective behaviors. In order to understand the determinants of this finding, we used the MMPI Clinical Scales to predict whether the person was exercising for sport or fitness during midlife and explore the role of gender differences in personality (Siegler et al., 1997). Our results were complex and interesting. For both men and women, individuals who were less depressed, less rebellious, and less socially introverted were more likely to be exercising at midlife. When there were gender differences, men who described themselves more favorably in college were more likely to be exercising, while women who described themselves more favorably in college were less likely to be exercising at age 40. We have recently examined the association of the five FFM factors at ages 42 and 50 and the likelihood of exercising at age 65. Being an exerciser at age 65 was associated with lower neuroticism and higher conscientiousness during midlife for both men and women (Huffman, Costa, Hauser, Kraus, & Siegler, 2016).

Higher hostility in college was associated with higher BMI at midlife. We evaluated the role of the FFM to predict changes in BMI over 14 years during midlife from ages 43-55. Changes in midlife weight were found associated with personality and with gender. Our results indicated that neuroticism was related to BMI only in women, extraversion was related

to BMI in men but not women, while conscientiousness was related to BMI in both men and women with those lower in conscientiousness gaining more weight, but the effect was stronger in women than in men (Brummett et al., 2006).

In Siegler et al. (2003), we evaluated the role of patterns of change in hostility from college to midlife to predict high risk status from ages 42-50 with 17 indices of high risk status. Our only gender difference was for reported family income which was significantly associated with hostility for women but not for men. In general, gains in hostility from college to midlife were associated with higher risk status, while declines in hostility were associated with lower risk status.

In Mortensen, Siegler, Barefoot, Gronbaek, & Sorenson (2006), we evaluated the directionality of changes in physical activity and BMI during midlife. Directionality was not clear. The results revealed an interaction between the two variables and suggest that for persons with higher BMIs physical activity may not be the same for those with normal weight, but the patterns were the same for both men and women.

Siegler, Brummett, Martin, & Helms (2013) categorized changes in partner status and their associations with survival. This paper indicated that having a partner from ages 40-60 vs. being divorced or single was predictive of survival into old age taking behavioral risk factors into account using time varying covariates.

Thus, across a variety of important domains, we have found individual differences in personality and health behaviors. Siegler and Davey (2012) evaluated the generalizability of these differences to older persons tested in two nationally representative studies – the Health and Retirement Study and the Georgia Centenarian Study (Poon & Perls, 2007). Our findings indicate the importance of study design on internal vs. external validity. In large population based studies that are nationally representative, the measurement of psychosocial characteristics such as personality is done with shorter forms that are less reliable which hampers the internal validity of the findings while enhancing the external validity as the full population is represented.

Summary and Conclusions

Starting with work on the Duke Longitudinal Studies (Siegler, 1983), my work on developmental health psychology (Siegler, 1989) and the UNCAHS (Hooker et al., 2010; Siegler & Ogle, in press) have implications for our current research on developing the genetic factors responsible for adherence to exercise interventions (Lewis et al., 2016; Singh et al., 2016). Current work is focused on applications of these ideas to the understanding of the psychology and biology of stress in the context of gene by environment interactions (see Singh et al., 2015) that are reflected in the design of the current PPG (see Figure 1b) and

their interaction with personality as a potential way to target exercise interventions to enhance their effectiveness. This is a completely new way to use information on individual differences in personality and behavior to improve an individual's chances of aging successfully.

Here we have focused on the contributions due to developmental timing of risk and protective factors that we have observed at college entry, then from ages 40 to 70, which represents 30 years of adult development seen in a cohort of Baby Boomers born in the 1940s. Members of this study population are also more likely to have the opportunity to survive an additional 30 years (Newman & Murabito, 2013).

This work has not been designed to develop policy prescriptions; but rather to improve the care that individuals receive who are lucky enough to be able to access the best medical care and benefit from evidence-based medicine. Thus individuals and their family members and those who care for them will have a better experience interacting with the health care system and medical professionals will have the information that they need to provide the best possible care.

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References

Barefoot, J.C., Brummett, B.H., Clapp-Channing, N.E., Siegler, I.C., Vitaliano, P.P., . . . Mark, D.B. (2000). Moderators of the effect of social support on depressive symptoms in cardiac patients. American Journal of Cardiology, 86, 438-442.

Bastian, L.A., Couchman, G.M., Rimer, B.K., McBride, C.M., Feaganes, J.R., & Siegler, I.C. (1997). Perceptions of menopausal stage and patterns of hormone replacement therapy use. Journal of Women's Health, 6, 467-475.

Berntsen, D., Rubin, D.C., & Siegler, I.C. (2011). Two versions of life: Emotionally negative and positive life events have different roles in the organization of life story and identity. Emotion, 11, 1190-1201.

Bosworth, H.B., Siegler, I.C., Brummett, B.H., Barefoot, J.C., Williams, R.B., Clapp-Channing, N., . . . Mark, D.B. (1999a). The association between self-rated health and mortality in a well-characterized sample of coronary artery disease patients. Medical Care, 37, 1226-1236.

Bosworth, H.B., Siegler, I.C., Brummett, B.H., Barefoot, J.C., Williams, R.B., Vitaliano, P.P., . . . Mark, D.B. (1999b). The relationship between self-rated health and health status among coronary artery patients. Journal of Aging and Health, 13, 565-584.

Bosworth, H.B, Siegler, I.C., Olsen, M.K., Brummett, B.H., Barefoot, J.C., & Williams, R.B., . . . Mark, D. B. (2000). Social support and quality of life in patients with coronary artery disease. Quality of Life Research, 9, 829-839.

Brummett, B.H., Babyak, M.A., Williams, R.B., Barefoot, J.C., Costa, P.T., & Siegler, I.C. (2006). NEO personality domains and gender predict levels and trends in body mass index over 14 years during midlife. Journal of Research in Personality, 40, 222-236.

Burroughs, A.R., Visscher, W.A., Haney, T., Efland, J.R., Barefoot, J.C., Williams, R.B., & Siegler, I.C. (2003). Community recruitment process by race, gender and SES gradient: Lessons learned from the Community Health and Stress Evaluation (CHASE) study experience. Journal of Community Health, 28, 421-437.

Costa, Jr., P.T., & McCrae, R.R. (1992). Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI) Professional Manual. Odessa, FL: Psychological Assessment Resources.

Costa, Jr., P.T., Herbst, J.H., McCrae, R.R., & Siegler, I.C. (2000). Personality at midlife: Stability, intrinsic maturation, and response to life events. Assessment, 7, 365-378.

Dahlstrom, W.G., Welsh, G.S., & Dahlstrom, L.E. (1975). An MMPI handbook: Research applications. Minneapolis, MN: University of Minnesota Press.

Dungan, J.R., Hauser, E.R., Qin, X., & Kraus, W.E. (2013). The genetic basis for survivorship in coronary artery disease. Frontiers in Genetics, 4, Article 191. http://dx.doi.org/10.3389/fgene.2013.00191

Edelman, C.D., & Siegler, I.C. (1978). Federal age discrimination in employment law: Slowing down the gold watch. Charlottesville, VA: The Michie Company.

Haberstick, B.C., Smolen, A., Williams, R.B., Bishop, G.D., Foshee, V.A., Thornberry, T.P., . . . Harris, K.M. (2015). Population frequencies of the Triallelic 5HTTLPR in six ethnicially diverse samples from North America, Southeast Asia, and Africa. Behavior Genetics, 45, 255-261.

Hooker, K., Hoppmann, C.A. & Siegler, I.C. (2010). Personality as a lifespan compass for health. In K.E. Whitfield (Ed.) Annual Review of Gerontology and Geriatrics (pp. 201-232). New York: Springer Publishing Company.

Huffman, K.M., Costa, P.T., Hauser, E.R., Kraus, W.E., & Siegler, I.C. (2016). increasing adherence to physical activity and exercise with personality and genetics. Manuscript in preparation.

Kraus, W.E.., Granger, C. B., Sketch, M.H., Donahue, M.P., Ginsburg, G.S., Hauser, E.R., . . . Shah, S.H. (2015). A guide for a cardiovascular genomics biorespository: The CATHGEN experience. Journal of Cardiovascular Translational Research, 8, 449-457.

Lewis, L.S., Huffman, K.M., Smith, I.F., Donahue, M.P., Slentz, C.A., Houmard, J.A., . . . Kraus, W.E. (2016). Genetic variation in acid ceramidase predicts non-completion of an exercise intervention. Manuscript submitted for publication.

McBride, C.M., Bastian, L.A., Halabi, S., Fish, L., Lipkus, I.M., Bosworth, H.B., . . . Siegler, I.C. (2002). A tailored intervention to aid decision-making about hormone replacement therapy. American Journal of Public Health, 92, 1112-1114.

Mortensen, L.H., Siegler, I.C., Barefoot, J.C., Gronbaek, M., & Sorensen, T.I. (2006). Prospective associations between sedentary lifestyle and BMI in midlife. Obesity, 14, 1462-1471.

Newman, A.B., & Murabito, J.M. (2013). The epidemiology of longevity and exceptional survival. Epidemiologic Reviews, 35, 181-197.

Ogle, C.M., Rubin, D.C., Berntsen, D., & Siegler, I.C. (2013). The frequency and impact of exposure to potentially traumatic events over the life course. Clinical Psychological Science, 1, 426-434.

Ogle, C.M., Rubin, D.C., & Siegler, I.C. (2013). The impact of the developmental timing of trauma exposure on PTSD symptoms and psychosocial functioning among older adults. Developmental Psychology, 49, 2191-2200.

Ogle, C.M., Rubin, D.C., & Siegler, I.C. (2016). Accounting for posttraumatic stress disorder symptoms with pre- and post-trauma risk factors: A longitudinal study. Clinical Psychological Science, 4, 272-286.

Ogle, C.M., Siegler, I.C., Beckham, J.C., & Rubin, D.C. (in press). Neuroticism increases PTSD symptom severity by amplifying the emotionality, rehearsal, and centrality of trauma memories. Journal of Personality.

Poon, L.W., & Perls, T.T. (Eds.). (2007). Annual Review of Gerontology and Geriatrics: Vol. 27. Biopsychosocial approaches to longevity. New York: Springer Publishing Company.

Power, C., Kuh, D., & Morton, S. (2013). From developmental origins of adult disease to life course research on adult development. Annual Review of Public Health, 34, 7-28.

Rubin, D.C., & Siegler, I.C. (2004). Facets of personality and the phenomenology of autobiographical memory. Applied Cognitive Psychology, 18, 913-930.

Rubin, D.C., Berntsen, D., & Bohni, M.K. (2008). A memory based model of posttraumatic stress disorder: Evaluating basic assumptions underlying the PTSD diagnosis. Psychological Review, 155, 958-1011.

Schlossberg, N.K., & Robinson S.P. (1996). Going to Plan B. New York: Simon and Shuster.

Siegler, I.C. (1982, November). The normal psychology of the aging male: Sex differences in life events. Paper presented at the Boston Society for Gerontologic Psychiatry. Boston, MA.

Siegler, I.C. (1983). Psychological aspects of the Duke Longitudinal Studies. In K.W. Schaie (Ed.), Longitudinal studies of adult psychological development (pp. 136-190). New York: Guilford Press.

Siegler, I.C. (1989). Developmental health psychology. In M. Storandt & G.R. Vanden Bos (Eds.), The adult years: Continuity and change (pp. 119-142). Washington, DC: American Psychological Association.

Siegler, I.C., Blumenthal, J.A., Barefoot, J.C., Peterson, B.L., Saunders, W.B., Dahlstrom, W.G., . . . Williams, R.B. (1997). Personality factors differentially predict exercise behavior in men and women. Women's Health: Research on Gender, Behavior and Policy, 3, 61-70.

Siegler, I.C., Brummett, B.H., Martin, P., & Helms, M.J. (2013). Consistency and timing of marital transitions and survival during midlife: The role of personality and health risk behaviors. Annals of Behavioral Medicine, 45, 338-347.

Siegler, I.C., Brummett, B.H., Williams, R.B., Haney, T.L., & Dilworth-Anderson, P. (2010). Caregiving, residence, race and depressive symptoms. Aging and Mental Health, 14, 771-778.

Siegler, I.C., & Costa, P.T. (1994). Personality and breast cancer screening behaviors. Annals of Behavioral Medicine, 16, 347-351.

Siegler, I.C., Costa, P.T., Brummett, B.H., Helms, M.J., Barefoot, J.C., Williams, R.B., . . . Rimer, B.K. (2003). Patterns of change in hostility from college to midlife in the UNC Alumni Heart Study predict high-risk status. Psychosomatic Medicine, 65, 738-745.

Siegler, I.C., & Davey, A. (2012). Behavioral stability and change in health across the lifecycle. In S.K. Whitbourne, & M. Sliwinski (Eds.), Handbook of developmental psychology: Adult development and aging (pp. 118-131). Cambridge MA: Wiley-Blackwell.

Siegler, I.C., Feaganes, J.R., & Rimer, B.K. (1995). Predictors of adoption of mammography in women under age 50. Health Psychology, 14, 274-278.

Siegler, I.C., Feaganes, J.R., & Rimer, B.K. (1996). Awareness of and responses to changes in the National Cancer Institute's guidelines for mammography in women aged 35-49. Journal of Women's Health, 5, 33-41.

Siegler, I.C., & George, L.K. (1983). Sex differences in coping and perceptions of life events. Journal of Geriatric Psychiatry, 16, 197-209.

Siegler, I.C., Kaplan, B.H., Von Dras, D.D., & Mark D.B. (1999). Cardiovascular health: A challenge for midlife. In S. Willis & J. Reid (Eds.), Life in the middle (pp. 147-157). San Diego, CA: Academic Press.

Siegler, I.C., Ogle, C.M., Rubin, D.C., Burke, G.L., Lyles, M.K., Kraus, W.E., . . . Williams, R.B. (2016). Developmental timing of lifetime posttraumatic stress disorder symptoms with prevalent coronary heart disease in the UNC Alumni Heart Study at age 61. Manuscript submitted for publication.

Siegler, I.C., & Ogle, C.M. (in press). Lifecourse perspective and health. In C. Llewellyn (Ed). Cambridge Handbook of Psychology, Health and Medicine. (3rd Edition). Cambridge UK: Cambridge University Press.

Siegler, I.C., Peterson, B.L., Barefoot, J.C., Harvin, S.H., Dahlstrom, W.G., Kaplan, B.H., . . . Williams, R.B. (1992). Using college alumni populations in epidemiologic research: The UNC Alumni Heart Study. Journal of Clinical Epidemiology, 45, 1243-1250.

Siegler, I.C., Peterson, B.L., Barefoot, J.C., & Williams, R.B. (1992). Hostility during late adolescence predicts coronary risk factors at mid-life. American Journal of Epidemiology, 136, 146-154.

Singh, A., Babyak, M.A., Brummett, B.H., Jiang, R., Watkins, L.L., Barefoot, J.C., . . . Williams, R.B. (2015). Computing a synthetic chronic psychosocial stress measurement in multiple datasets and its application in the replication of G x E interactions of the EBF1 gene. Genetic Epidemiology, 39, 489-497.

Singh, A., Babyak, M.A., Nolan, D.K., Brummett, B.H., Jiang, R., Siegler, I.C., . . . Hauser, E.R. (2015). Gene by stress genome-wide interaction analysis and path analysis identify EBF1 as a cardiovascular and metabolic risk gene. European Journal of Human Genetics, 23, 854-862.

Singh, A., Hauser, E.R., Johnson, J.L., Babyak, M.A., Brummett, B.H., Jiang, R., . . . Kraus, W.E. (2016, October). Follow-up of G x E interactions: EBF1 GxE association, synthetic chronic psychosocial stress and drop-out from a structured exercise program. To be presented at the 25th meeting of International Genetic Epidemiology Society, Toronto, CA.

Von Dras, D.D., Siegler, I.C., Barefoot, J.C., Williams, R.B., & Mark, D.B. (2000). Coronary catherization patient and wife's perception of social support: Effects due to characteristics of recipient, provider and their interaction. International Journal of Aging and Human Development, 50, 97-125.

Von Dras, D.D., Siegler, I.C., Williams, Jr., R.B., Clapp-Channing, N., Haney, T., & Mark, D.B. (1997). Surrogate assessment of coronary artery disease patients' functional capacity. Social Science & Medicine, 44, 1491-1502.

Williams, R.B. (2008). Psychosocial and biobehavioral factors and their interplay in coronary heart disease. Annual Review of Clinical Psychology, 4, 349–365.

Williams, R.B. (2016, March). Distinguished Scientist Award Lecture: The Mind-Body Problem -- Progress Report 57 years on. Presentation at the 74th Annual Scientific Meeting of the American Psychosomatic Society, Denver Colorado.

Williams, R.B., Barefoot, J.C., Califf, R.M., Haney, T.L., Saunders, W.B., Pryor, D.B., . . . Mark, D.B. (1992). Prognostic importance of social and economic resources among medically treated patients with angiographically documented coronary artery disease. Journal of the American Medical Association, 267, 520-524.