Published in final edited form as:

West J Nurs Res. 2018 March ; 40(3): 375–387. doi:10.1177/0193945917697219.

Development of the Systems Thinking Scale for Adolescent Behavior Change

Shirley M. Moore¹, Vilailert Komton¹, Clara Adegbite-Adeniyi¹, Mary A. Dolansky¹, Heather K. Hardin¹, and Elaine A. Borawski¹

¹Case Western Reserve University, Cleveland, OH, USA

Abstract

This report describes the development and psychometric testing of the Systems Thinking Scale for Adolescent Behavior Change (STS-AB). Following item development, initial assessments of understandability and stability of the STS-AB were conducted in a sample of nine adolescents enrolled in a weight management program. Exploratory factor analysis of the 16-item STS-AB and internal consistency assessments were then done with 359 adolescents enrolled in a weight management program. Test–retest reliability of the STS-AB was .71, $p = .03$; internal consistency reliability was .87. Factor analysis of the 16-item STS-AB indicated a one-factor solution with good factor loadings, ranging from .40 to .67. Evidence of construct validity was supported by significant correlations with established measures of variables associated with health behavior change. We provide beginning evidence of the reliability and validity of the STS-AB to measure systems thinking for health behavior change in young adolescents.

Keywords

systems thinking; instrumentation; psychometrics; adolescent; health behavior

Assisting individuals to adopt and maintain healthy lifestyle behaviors remains a major challenge. Socioecological theories of health behavior (Bronfenbrenner, 1979, 2005; Glass & McAtee, 2006) suggest that the environment is a major influence on the performance of healthy living behaviors, such as eating, exercise, and sleep. The environment comprising the systems of our daily home and work routines (habits) is a major influence on lifestyle behaviors. For example, how food is purchased and prepared in a family is a system associated with healthy eating. Similarly, how a morning routine is structured in a household influences the type of breakfast that is eaten by family members. Recent literature suggests that a fruitful approach to health behavior change is our ability to view our daily habits as a

Reprints and permissions: sagepub.com/journalsPermissions.nav

Corresponding Author: Shirley M. Moore, Edward J. and Louise Mellen Professor of Nursing, Frances Payne Bolton School of Nursing, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106-4904, USA., mmm8@case.edu.

Authors' Note

The content is solely the responsibility of the authors and does not necessarily represent the official views of the Robert Wood Johnson Foundation or the National Heart, Lung, and Blood Institute or the National Institutes of Health.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

set of behaviors comprising systems in our lives that can be examined and changed (Alemi et al., 2000; Moore & Charvat, 2012; Moore et al., 2011; Moore, Jones, & Alemi, 2016; Russell, 2010; Webel et al., 2013). This involves the ability to engage in systems thinking. Systems thinking is the ability to recognize and synthesize patterns, interactions, and interdependencies in a set of activities designed for a specific purpose. This includes the ability to recognize patterns and repetitions in the interactions and an understanding of how actions and components can reinforce or counteract each other (Dolansky & Moore, 2013). These relationships and patterns occur at different dimensions: temporal, spatial, social, technical, or cultural (Oshry, 2007). Systems thinking links people's environment to their behavior (Dolansky & Moore, 2013). Systems thinking as a concept has been applied in several fields, including biology, quality improvement, education, and engineering (Batalden & Stoltz, 1993; Senge, 2006). The application of systems thinking to behavior change is relatively new; however, a growing body of literature acknowledges the multiple person–environment interactions involved in forming and changing health behaviors (Alemi & Neuhauser, 2005; Duhigg, 2012).

Need for a Measure of Systems Thinking for Health Behavior Change

Systems thinking can be taught and learned (Aboumatar et al., 2012; Dolansky & Moore, 2013; Moore, Dolansky, Singh, Palmieri, & Alemi, 2010), and increasingly is a component of behavior change interventions (Moore et al., 2016; Plow et al., 2013; Russell, 2010; Webel et al., 2013). However, to date, there has not been a valid and reliable measure of systems thinking for health behavior change. To advance our understanding of the role of systems thinking as a possible key factor in making behavior changes and to assess our ability to change levels of systems thinking in individuals, valid and reliable measures of systems thinking for behavior change are needed.

Purpose

The purpose of this report is to describe the development and psychometric testing of the Systems Thinking Scale for Adolescent Behavior Change (STS-AB).

Method

Over the past few years, our team has engaged in a series of studies to develop several measures of systems thinking for use in specific contexts. Figure 1 describes the phases and activities of the development of the STS-AB, including a preliminary project in which the first measure of systems thinking was developed to assess systems thinking of health care professionals for use in changing health care systems as part of quality improvement initiatives. Our team then adapted this measure to address systems thinking by individuals for health behavior change, including adolescents.

Preliminary Project

The STS-AB was adapted from a measure of systems thinking, the Systems Thinking Scale (STS), that members of our team developed for use with health care professionals involved in health care system quality improvement initiatives (Moore et al., 2010). Although systems

thinking is viewed as a key component in health care process improvement (Batalden & Leach, 2009; Batalden & Mohr, 1997; Batalden & Stoltz, 1993; Senge, 2006), no psychometrically sound instrument existed to measure the extent to which individuals engaged in systems thinking as part of health care improvement. With initial funds from the Robert Wood Johnson Foundation, Dolansky and Moore (2013) began the development of the STS by engaging an expert panel of 10 leaders in the field of quality improvement and systems thinking worldwide in a series of electronic discussions to define and develop the conceptual domains of systems thinking that then formed the basis for the item-bank of questions for the questionnaire under development. The domains identified were sequence of events, causal sequence, multiple causations possible, variation of different types (random/special), feedback, interrelations of factors, and patterns of relationships. The STS was then refined through a series of interviews and factor analyses in a sample of health care professionals engaged in quality improvement work. The final STS consists of 20 items to which respondents indicate on a 5-point Likert-type scale ranging from “never” (0) to “most of the time” (4) the extent to which they engage in systems thinking regarding making improvements in health care systems. A total score is computed by summing the responses for each item; higher scores indicate greater use of systems thinking.

Psychometric testing was conducted on the final 20-item version to determine the construct, discriminate, and predictive validity and reliability (internal consistency and test–retest) of the STS ($n = 550$). The final 20-item STS had good reliability and construct and discriminate validity (Moore et al., 2010). More information about the STS which was designed for health professionals’ process improvement initiatives can be found at <https://nursing.case.edu/research/labs-studies/systems-thinking/>

Development of the STS-AB: Phase 1—The STS was then adapted for use in a new context: Adolescents engaged in changing systems of behaviors in their daily routines for healthier living. The adolescent behavior change version (STS-AB) was developed as part of the pilot study phase of a large multisite trial in which we tested the effects of a weight management intervention for overweight and obese inner-city adolescents (Moore, Borawski, Cuttler, Ievers-Landis, & Love, 2013). In 2011, during Phase 1 of the STS-AB development, a group of six individuals with expertise in health behavior change, child psychology, or systems thinking met several times and made suggestions for revising the original STS questions for use with adolescents engaged in health behavior change. The adaptations made in the STS included omitting four items that addressed work units and organization mission and goals and changing questions that referred to employees and supervisors to refer to family members and parents. The resulting STS-AB consists of 16 items to which children indicate on a 5-point Likert-type scale ranging from “never” (0) to “most of the time” (4) the extent to which they engage in systems thinking regarding making a health behavior change. Table 1 displays the items of the STS-AB. The stem sentence to the items on the questionnaire is, “When I want to make a change to be healthier ...” A total score is computed by summing the responses for each item. Scores can range from 0 to 80, with higher scores indicating greater use of systems thinking.

Sample: Initial assessments of understandability and stability of the STS-AB were conducted in a sample of nine urban adolescents enrolled in the pilot phase of the larger weight management trial focused on healthy living behaviors. Potential participants were identified during a middle-school body mass index (BMI) and blood pressure screening program of a large Midwest urban school district. Subjects were enrolled at the end of the fifth grade. Participants had a mean age of 12.5 years ($SD = 0.85$) and included three girls and six boys. They were predominately African American (92%) and were from low-income families (64% had an annual household income of less than US\$25,000). All were overweight or obese.

Procedures: Written informed consent and assent were obtained in private from parent and child prior to data collection. In both phases of the STS-AB instrument development, data were obtained in private interviews with trained personnel using audio-assisted survey software from which data were entered directly into a laptop or iPad. Measures of systems thinking were obtained at baseline and 4 and 8 months later. The STS-AB was found to be easily understood by the children as assessed by specific questions about its ease of use and understandability. Test-retest reliability at the 4-month period was .71, $p = .03$ and .68 ($p = .07$), after 8 months, indicating that systems thinking regarding behavior change in adolescents is a relatively stable skill unless specific effort is made to change levels of systems thinking. Initial validity of the STS-AB was also assessed at the end of an 8-month follow-up period when systems thinking scores of these nine adolescents who did not have systems thinking training were compared with the scores of 10 children who had been randomly assigned to receive 8 months of systems thinking training in a weight management program. Although not reaching significance in this small pilot study, systems thinking scores were higher in children who received systems thinking training ($M = 55.1$, $SD = 6.5$) as compared with children not receiving training ($M = 50.6$, $SD = 10.6$).

Psychometric testing of the STS-AB: Phase 2

Sample: In a second development phase, exploratory factor analysis of the 16-item STS-AB, evaluations of internal consistency, and further confirmations of validity were conducted using the baseline data of 359 urban adolescents enrolled from 2012 to 2014 in a large weight management trial (Moore et al., 2013). Table 2 describes the demographic characteristics of the participants included in these evaluations ($N = 359$). Participants had a mean age of 11.4 ($SD = 0.55$) and a mean BMI of 27.15 ($SD = 4.86$). Thirty-three percent were overweight and 67% were obese. Participants were predominately African American with low household incomes. As the children were all recruited from the same school grade level, there was little variance in age.

Procedures: Similar to the pilot study, overweight and obese participants were identified from a school-based BMI and blood pressure screening program of a large inner-city school system at the end of their fifth-grade year and data were gathered in standardized interviews using audio-assisted surveys on iPads. Data were stored in REDCap, a secure database management system with a password protection system. SPSS version 21.0 was used for data analysis. Descriptive statistics were used to depict the demographic characteristics of the study sample.

Analysis plan: For psychometric testing, exploratory factor analysis was used to determine the underlying structure of the STS-AB, with primary factor loadings of 0.40 or higher used as an indicator of a good factor solution (Osborne & Costello, 2009). Internal consistency reliability was assessed using Cronbach's alpha coefficients. Pearson product-moment correlations were used to examine the concurrent validity of the scale in which the associations between the scores of the STS-AB and other established measures of variables commonly associated with health behavior change were explored. These included self-regulation for behavior change (measured using the Index of Self-Regulation; Fleury, 1998), self-efficacy for diet (measured using the Child Dietary Self-Efficacy Scale; Parcel et al., 1995), and self-efficacy for exercise (measured using the Self-Efficacy in Overcoming Barriers to Physical Activity in Children; Saunders et al., 1997).

Results

Table 3 shows the means, standard deviations, and ranges of the systems thinking scores for the whole sample and by gender and BMI status. Scores on the STS-AB were normally distributed in this population (skewness = -0.31, kurtosis = 0.38). There were significant differences in systems thinking scores between children who were overweight and those who were obese ($t = -2.4$, $p = .02$), with obese children having higher levels of systems thinking than overweight children. There was no significant difference in systems thinking scores by gender.

Exploratory factor analysis was performed to assess the underlying dimensions of the STS-AB. The principal axis factoring method of extraction with five different types of rotations (direct oblimin, promax, equamax, quartimax, and varimax) were used to extract the minimum number of factors that explained the maximum variance of the scale. The results from eigenvalues and the scree plot revealed a single factor that explained 31% of the variance. When examining factor loadings, it was clear that all 16 items loaded strongly and cleanly on one factor with loadings ranging from 0.40 to 0.67 (Table 1). We found that a one-factor solution had a better fit than other factor solutions (two-, three-, four-, five-factor solutions), supporting a unidimensional model.

Evidence of concurrent validity was supported by significant correlations with established measures of other variables commonly associated with health behavior change. Systems thinking was positively associated with self-regulation ($r = .49$, $p < .00$), self-efficacy for diet ($r = .21$, $p < .00$), and self-efficacy for physical activity ($r = .13$, $p = .02$).

The internal consistency reliability coefficient was .87. Item analysis performed on each item indicated that inter-item correlations ranged from .16 to .45, and item-total correlations ranged from .37 to .62. Removing items from the scale did not improve the reliability of the measure; therefore, no items were removed.

Discussion

We found strong beginning evidence of the validity and reliability of the STS-AB to measure systems thinking for health behavior change in middle-school-aged adolescents. Internal consistency of the STS-AB is in the good-to-excellent range (Cronbach, 1951; Kottner &

Streiner, 2010; Polit & Beck, 2008). Results of the factor analysis showed a single factor with no underlying dimensions indicated; item analysis showed that no items needed to be removed from the scale. The availability of a measure of systems thinking for health behavior change in adolescents will assist investigators to further investigate the knowledge and skills associated with systems thinking in behavior change and examine its possible role as a mechanism of behavior change interventions.

A surprising finding was that higher levels of systems thinking were found in obese as compared with overweight children. This seems counterintuitive in that it is assumed that individuals who have higher levels of systems thinking would be more likely to engage in activities to influence daily routines associated with weight management. This assumption may be wrong, however, as it is possible that understanding a system is different from the ability or the influence to change a system. It is possible that many of the daily routines (systems associated with lifestyle behaviors) of adolescents are not under their direct control. An 11- to 12-year-old age group is just beginning to have some autonomy over their lifestyle habits, with many children still highly influenced by family and peer habits and routines (Faith et al., 2012; Stormshak et al., 2011). Although the STS-AB has several items to which the respondents rate the extent to which they recognize the influence of their family and friends on their attempts to make behavior change, they may not be able to influence a change. Another possible explanation for the finding of higher levels of systems thinking in obese compared with overweight adolescents could be that obese adolescents may be more likely to view external forces as the cause. In our ongoing trial in which we are measuring the mediating effect of systems thinking on diet, physical activity, and sleep patterns, we will be able to further examine this finding of higher levels of systems thinking in adolescents who are obese as compared with overweight.

Although this study has several strengths (i.e., strong theoretical underpinnings, sufficient sample size, standardized data collection protocols), there are some limitations. First, the restricted age range of our sample limits the generalizability of results to a narrow adolescent group. Also, the sample was limited to adolescents who were overweight and obese and enrolled in a weight management trial. Thus, the use of this measure to measure systems thinking in other populations of adolescents engaged in health behavior change is not known. The adolescents in the current study, however, were focused on making changes in several lifestyle behaviors, including diet, exercise, sedentary activity, sleep, and stress management. Nevertheless, it is unknown if the STS-AB currently is a good measure of systems thinking in adolescents engaged in making health behavior changes in other important health behaviors for this age group, such as tobacco use and substance abuse. Furthermore, this inner-city sample is predominately low income and African American, and thus, it is unknown if the instrument is appropriate for children of other racial/ethnic and socioeconomic groups.

Our next step in the development of the STS-AB will be to assess its predictive ability. In our existing ongoing trial, we will have the opportunity to assess the extent to which systems thinking is a mediator of health behavior change and if scores on the STS-AB are associated with positive health behavior change. In addition, we are currently assessing an adult version of a measure of systems thinking for behavior change (STS-AdultBehav). Results of further

testing of both the adult and the adolescent versions of the measure of systems thinking for health behavior change will provide considerable information about the role of systems thinking as a possible important factor for health behavior change.

In summary, rigorous methods were used to develop and evaluate the psychometric properties of the STS-AB to assess systems thinking associated with adolescent health behavior change. Psychometric testing indicates beginning evidence of the validity and reliability of the measure. Knowledge in an emerging field is advanced more rapidly when measures of concepts central to that field are available. The STS-AB offers the ability to determine the importance of systems thinking in making behavior change by adolescents and contribute to our understanding of mechanisms underlying making behavior change. Further testing of the validity and stability of the instrument in other populations is recommended.

Acknowledgments

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The project described was supported by grants from the Robert Wood Johnson Foundation and the NIH Award Number U01HL103622 from the National Heart, Lung, and Blood Institute, the Eunice Kennedy Shriver National Institute of Child Health and Development, and the Office of Behavioral and Social Sciences Research.

References

- Aboumatar HJ, Thompson D, Wu A, Dawson P, Colbert J, Marsteller J, ... Pronovost P. Development and evaluation of a 3-day patient safety curriculum to advance knowledge, self-efficacy, and system thinking among medical students. *British Medical Journal Quality & Safety*. 2012; 21:416–422. DOI: 10.1136/bmjqs-2011-000463
- Alemi, F., Neuhauser, D. A thinking person's weight loss and exercise program. Victoria, British Columbia, Canada: Trafford; 2005.
- Alemi F, Neuhauser D, Ardito S, Headrick L, Moore S, Hekelman F, Norman L. Continuous self-improvement: Systems thinking in a personal context. *The Joint Commission Journal on Quality Improvement*. 2000; 26:74–86. [PubMed: 10672505]
- Batalden PB, Leach DC. Sharpening the focus on systems-based practice. *Journal of Graduate Medical Education*. 2009; 1:1–3. DOI: 10.4300/01.01.0001 [PubMed: 21975699]
- Batalden PB, Mohr JJ. Building knowledge of health care as a system. *Quality Management in Health Care*. 1997; 5(3):1–12.
- Batalden PB, Stoltz PK. A framework for the continual improvement of health care: Building and applying professional and improvement knowledge to test changes in daily work. *The Joint Commission Journal on Quality Improvement*. 1993; 19:424–447. [PubMed: 8252125]
- Bronfenbrenner, U. *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press; 1979.
- Bronfenbrenner, U. The bioecological theory of human development. In: Bronfenbrenner, U., editor. *Making human beings human: Bioecological perspectives on human development*. Thousand Oaks, CA: SAGE; 2005. p. 3-15.
- Cronbach L. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951; 16:297–334. DOI: 10.1007/BF02310555
- Dolansky MA, Moore SM. Quality and safety education for nurses (QSEN): The key is systems thinking. *The Online Journal of Issues in Nursing*. 2013; 18(8) Article 1.
- Duhigg, C. *The power of HABIT: Why we do what we do in life and business*. New York, NY: Random House; 2012.

- Faith MS, Van Horn L, Appel LJ, Burke LE, Carson JA, Franch HA. ... Council on the Kidney in Cardiovascular Disease. Evaluating parents and adult caregivers as “agents of change” for treating obese children: Evidence for parent behavior change strategies and research gaps: A scientific statement from the American Heart Association. *Circulation*. 2012; 125:1186–1207. DOI: 10.1161/CIR.0b013e31824607ee [PubMed: 22271754]
- Fleury J. The index of self-regulation: Development and psychometric analysis. *Journal of Nursing Measurement*. 1998; 6:3–17. [PubMed: 9769608]
- Glass TA, McAtee MJ. Behavioral science at the crossroads in public health: Extending horizons, envisioning the future. *Social Science & Medicine*. 2006; 62:1650–1671. [PubMed: 16198467]
- Kottner J, Streiner DL. Internal consistency and Cronbach’s alpha: A comment on Beeckman et al. (2010). *International Journal of Nursing Studies*. 2010; 47:926–928. DOI: 10.1016/j.ijnurstu.2009.12.018 [PubMed: 20307880]
- Moore SM, Borawski EA, Cuttler L, Ievers-Landis CE, Love TE. IMPACT: A multi-level family and school intervention targeting obesity in urban youth. *Contemporary Clinical Trials*. 2013; 36:574–586. [PubMed: 24008055]
- Moore SM, Charvat JM. SystemCHANGE: Results of a lifestyle exercise intervention trial. *Annals of Behavioral Medicine*. 2012; 43(1):S79.
- Moore SM, Charvat JM, Alemi F, Gordon N, Ribisl P, Rocco M. Improving lifestyle exercise in cardiac patients: Results of the SystemCHANGE trial. *Circulation*. 2011; 124 Article A13341.
- Moore, SM., Dolansky, MA., Singh, M., Palmieri, P., Alemi, F. The Systems Thinking Scale. 2010. Retrieved from https://nursing.case.edu/nursing/media/nursing/pdf-dox/STS_Manual.pdf
- Moore SM, Jones L, Alemi F. Family self-tailoring: Applying a systems approach to improving family healthy living behaviors. *Nursing Outlook*. 2016; 64:306–311. [PubMed: 27301950]
- Osborne JW, Costello A. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Pan-Pacific Management Review*. 2009; 12:131–146.
- Oshry, B. Seeing systems: Unlocking the mysteries of organizational life. San Francisco, CA: Berrett-Koehler; 2007.
- Parcel GS, Edmundson E, Perry CL, Feldman HA, O’Hara-Tompkins N, Nader PR, ... Stone EJ. Measurement of self-efficacy for diet-related behaviors among elementary school children. *The Journal of School Health*. 1995; 65:23–27. [PubMed: 7731197]
- Plow M, Moore SM, Kirwan JP, Frost F, Katzan I, Jaeger S, Alberts J. Randomized controlled pilot study of a SystemCHANGE weight management intervention in stroke survivors: Rationale and protocol. *Trials*. 2013; 14 Article 130. doi: 10.1186/1745-6215-14-130
- Polit, D., Beck, C. Nursing research: Generating and assessing evidence for nursing practice. 8. Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins; 2008.
- Russell CL. A clinical nurse specialist-led intervention to enhance medication adherence using the plan-do-check-act cycle for continuous self-improvement. *Clinical Nurse Specialist*. 2010; 24:69–75. [PubMed: 20168141]
- Saunders RP, Pate RR, Felton G, Dowda M, Weinrich MC, Ward DS, ... Baranowski T. Development of questionnaires to measure psychosocial influences on children’s physical activity. *Preventive Medicine*. 1997; 26:241–247. DOI: 10.1006/pmed.1996.0134 [PubMed: 9085394]
- Senge, PM. The fifth discipline: The art and practice of the learning organizations. New York, NY: Doubleday; 2006.
- Stormshak EA, Connell AM, Veronneau MH, Myers MW, Dishion TJ, Kavanagh K, Caruthers AS. An ecological approach to promoting early adolescent mental health and social adaptation: Family-centered intervention in public middle schools. *Child Development*. 2011; 82:209–225. DOI: 10.1111/j.1467-8624.2010.01551.x [PubMed: 21291438]
- Webel AR, Moore SM, Hanson JE, Patel SR, Schmotzer B, Salata RA. Improving sleep hygiene behavior in adults living with HIV/AIDS: A randomized control pilot study of the SystemCHANGE(TM)-HIV intervention. *Applied Nursing Research*. 2013; 26:85–91. [PubMed: 23265919]

Preliminary Project: Development of the Systems Thinking Scale (STS) for use for health care system improvement by health care professionals.
Item generation by a panel of 10 experts; Psychometric assessment of the 20-item Systems Thinking Scale (STS) (N= 342 health care professionals and 224 health care professions students).

Development of the Systems Thinking Scale for Adolescent Behavior Change (STS-AB)
Phase 1: Revision of the STS for use in health behavior change by adolescents.
Item revision of the STS by expert panel (N=6); Initial assessments of understandability and stability of the 16- item STS-AB (N= 9 urban-dwelling adolescents).

Phase 2: Assessment of validity and reliability of the STS-AB.
Factor analysis of the 16- item STS-AB; Assessment of internal consistency; Initial validity assessments (N=359 urban-dwelling adolescents).

Figure 1.

Phases and activities in development of the STS-AB.

Note. STS-AB = Systems Thinking Scale for Adolescent Behavior Change.

Table 1STS-AB Exploratory Factor Analysis Results ($N = 359$).

Item	<i>M</i>	<i>SD</i>	Factor 1
I think about how everything I do can affect my health.	3.29	1.24	0.67
I think small changes can produce big results.	3.51	1.20	0.64
I try and find someone to help me.	3.11	1.34	0.63
I keep our family's routines in mind.	3.22	1.34	0.62
I realize that I need to change the things I do in my daily routines.	3.37	1.26	0.61
I consider how our family has done things in the past.	3.19	1.36	0.61
I suggest ideas to my parents of how we all could be healthier in my family.	3.19	1.28	0.60
I keep in mind that the changes I make can affect the whole family.	3.05	1.32	0.57
I think about the things that I can do every day that will make me healthier.	3.55	1.22	0.54
I think about how the changes I want to make in the way I do things will affect what I do with my friends.	2.83	1.36	0.53
I think it depends on more people than just me.	3.23	1.34	0.52
I ask the opinions of my friends.	2.61	1.41	0.48
I ask the opinions of everyone in my family.	2.91	1.36	0.48
I recognize that the current things I do will affect my health in the future.	3.24	1.29	0.47
I try and figure out what is causing me not to have healthier behaviors.	2.99	1.30	0.47
I think the participation of everyone in my family is important.	3.75	1.24	0.40

Note. STS-AB = Systems Thinking Scale for Adolescent Behavior Change.

Table 2

Characteristics of Sample for Factor Analysis and Internal Consistency Analyses of STS-AB ($N = 359$).

Characteristics	<i>n</i>	%
Gender		
Male	151	42.1
Female	208	57.9
Ethnicity/race		
Non-Hispanic Black	277	76.9
Hispanic	59	16.4
Non-Hispanic White	14	3.9
Other	9	2.5
Household income		
<US\$15,000	124	37.8
US\$15,000–US\$24,999	80	24.4
US\$25,000–US\$34,999	49	14.9
US\$35,000–US\$49,999	37	11.3
US\$50,000–US\$74,999	26	7.9
US\$75,000–US\$149,999	11	3.4
US\$150,000–US\$199,999	1	0.3

Note. STS-AB = Systems Thinking Scale for Adolescent Behavior Change.

Table 3

Means, Standard Deviations, and Ranges of Systems Thinking Scores for the Whole Sample and by Gender and BMI Status.

	<i>M</i>	<i>SD</i>	Range
Whole group (<i>N</i> = 359)	51.04	12.30	16–80
BMI status *			
Overweight	48.81	12.13	16–80
Obese	52.12	12.27	16–80
Gender			
Male	50.11	11.99	16–80
Female	51.71	12.51	16–80

Note. BMI = body mass index.

*
p = .02.