

The Study of Exercise and Nutrition in Older Rhode Islanders (SENIOR): translating theory into research

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Abstract

Innovative and effective health promotion interventions targeted on older adults within a public health framework will be increasingly important as the US population ages dramatically. The benefits of healthier lifestyles for older adults include increased functional ability and improved quality of life. The Study of Exercise and Nutrition in Older Rhode Islanders (SENIOR) Project is a multi-behavioral health promotion intervention for community-dwelling older adults focusing on increasing exercise and fruit and vegetable consumption. Intervention materials are stage-tailored for each individual, and include manuals, newsletters, expert system assessments and reports, and telephone coaching. The primary purpose of the SENIOR Project is to investigate the relative effectiveness of a multiple-behavior intervention—based on a single theoretical framework—compared to single-behavior interventions. The secondary purposes are to investigate the intervention's effects on both functional ability and general health outcomes, and how older adults move along a continuum of changing health

behaviors. The Transtheoretical Model of Health Behavior Change, the conceptual framework for the SENIOR Project, was chosen for the following reasons: performance potential with older adults, individual tailoring on a stage basis, technological features, and interdisciplinary research base and community partnership.

Introduction

The Study of Exercise and Nutrition in Older Rhode Islanders (SENIOR) Project is a large-scale, community-based health promotion intervention to encourage older adults to exercise more, and to improve their diet by increasing their intake of fruits and vegetables. It is unique in combining a public health recruitment model with an individually tailored intervention. The study is based on the Transtheoretical Model (TTM) of Health Behavior Change, and is a 2×2 experimental design with the following groups: (1) exercise only, (2) nutrition (fruits and vegetables only), (3) combined exercise and nutrition, and (4) control. The 12-month stage-tailored intervention includes manuals, newsletters, expert system assessments and reports, and telephone coaching. Outcomes—including level of exercise and servings of fruits and vegetables—are assessed at baseline, and 12 and 24 months.

There are two foundations for the importance of this health promotion project that make it unique: an investigation of multiple-behavior interventions and a focus on an older adult population. Together these constitute the essential rationale for the project.

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Multiple-behavior interventions

It is important to investigate multiple-behavior interventions in health promotion research, as their potential impact on public health may be superior compared to single-behavior interventions. Exercise and nutrition behaviors were chosen by the SENIOR Project because of their importance to healthy lifestyles in older adults. Multiple-behavior research introduces several hypotheses concerning intervention effectiveness that need to be empirically tested (i.e. overburdening hypothesis, enhancement hypothesis and additivity hypothesis). Under the overburdening hypothesis, the single risk factor interventions for exercise and nutrition show greater increases in exercise and nutrition, respectively, than shown by the multiple risk factor intervention (i.e. the exercise plus nutrition intervention group). Under the enhancement hypothesis, the exercise plus nutrition intervention group shows greater increases in both exercise and nutrition than either of the single risk factor interventions due to an interaction effect. The additivity hypothesis assumes that the exercise and nutrition interventions work independently. Under this hypothesis, no interaction effect would be observed for either the exercise- or nutrition-dependent variables. It is important to note that either the enhancement or additivity hypothesis is considered positive when using multiple interventions, as delivery is economized in the additivity scenario (a 'two for one' package) and the positive impact of the enhancement hypothesis is obvious.

Older adult population

Older adults represent the fastest growing population group in the US and one for which the development of public health interventions will be increasingly important (Hickey *et al.*, 1997). There is growing interest in the potential of research on aging and health behavior to contribute to the development of interventions targeted on older adults (Ory *et al.*, 1992; Ory and DeFries, 1998). Research evidence indicates that some of the chronic health problems associated with old

age may be prevented or at least postponed and controlled—thereby reducing the burden of chronic disease and improving functional ability (Olshansky and Rudberg, 1997). It has also been well documented that regular exercise and good nutrition can have a positive effect on the progression of disease and functional status in older adults, even when these behavioral changes are initiated in old age (US Department of Health and Human Services, 1996, 1997).

In spite of the many benefits of healthier lifestyles for older adults, studies have indicated that fewer than 10% of persons over the age of 65 regularly perform physical activities that enhance or maintain muscular strength and endurance (Ory *et al.*, 2002). Similarly, with regard to nutrition behavior, fewer than 40% of persons over the age of 60 consume the recommended five servings a day of fruits and vegetables (Krebs-Smith *et al.*, 1996).

The SENIOR Project

The primary purpose of the SENIOR project is to investigate the relative effectiveness of a multiple-behavior intervention (exercise and nutrition) compared to single-behavior interventions. This study is a 2×2 experimental design with the following groups: (1) exercise intervention only, (2) nutrition intervention focusing on fruits and vegetables only, (3) combined exercise and nutrition, and (4) a control group receiving fall prevention materials. The secondary purposes are: (1) to investigate the interventions' effects on both functional ability and general health outcomes, and (2) to investigate how older adults move along a continuum of changing their health-related behaviors.

For purposes of assessing participants in the research study, regular exercise is defined as:

...any planned physical activity (e.g. brisk walking, jogging, bicycling, swimming, line dancing, tennis, etc.) performed to increase physical fitness. Such activity should be performed 3 times or more per week for 20 min or more per session at a level that increases your breathing rate and causes you to break a sweat.

However, data are also collected on overall levels of daily physical activity. Intervention materials are all targeted generally on increasing levels of physical activity and particularly on developing a regular schedule of exercise. Similarly, the behavioral focus of the nutrition intervention is on the consumption of at least five servings a day of fruits and vegetables, and this is the target threshold used in assessing participants for stage classification (Laforge *et al.*, 1994). The various intervention materials are all focused on encouraging participants to eat more fruits and vegetables every day. However, for those already consuming five servings a day, materials encourage variety and increased consumption of nutrient-rich fruits and vegetables.

The stage-tailored intervention guided by the TTM expert system is delivered by mail and telephone, and includes a manual, newsletters, expert system assessments and reports, and coaching phone calls for the 12-month intervention in groups 1, 2 and 3. The SENIOR Project expert system is individually tailored and re-tailored on four occasions (baseline, and 4, 8 and 12 months) on all four TTM constructs: stages, processes, decisional balance and self-efficacy. For example, individuals in the precontemplation stage should increase their evaluation of the pros or benefits of change; they should also use consciousness raising, dramatic relief and environmental re-evaluation processes of change to progress to the next stage. Individuals in the action stage, on the other hand, should apply quite different processes and strategies, such as stimulus control, reinforcement management and helping relationships [see (Prochaska and Velicer, 1997) for a detailed discussion of stages and corresponding processes].

SENIOR outcome measures include objective and subjective physical activity and nutrition assessments; stage and processes of change, decisional balance and self-efficacy assessments; and the Medical Outcomes Study Short Form SF-36 (McHorney *et al.*, 1993).

The target population is 1300 community-dwelling older persons 65 years of age and older in the City of East Providence (Rhode Island) who

meet the inclusion criteria. East Providence has the highest percentage of older persons in the state (20%), including a significant multicultural population of Portuguese, Cape Verdean and Hispanic representation.

Theoretical approach

The process of theory selection is the primary focus of this discussion [for a recent description of the framework chosen—the TTM—see (Prochaska and Velicer, 1997)]. Briefly, the TTM is a multi-dimensional theory of behavioral change that incorporates the stages of change with the processes of change, decisional balance and self-efficacy. Four major factors contributed to the selection of the TTM for the current project, ranging from perceived gaps in the research to very practical considerations regarding technology and resource availability: performance potential with older adults, individual tailoring on a stage basis, technological features, and interdisciplinary research base and community partnership.

Performance potential with older adults

The first consideration in choosing a theoretical base for the SENIOR Project was that, in general, TTM-based tailored interventions have been found to outperform best practice intervention programs. (Prochaska *et al.*, 1993, 2001; Velicer *et al.*, 1999). Further, the TTM has guided several successful intervention studies for various behaviors, and has outperformed best practices in the areas of nutrition and exercise behavior change (Brug *et al.*, 1996; Marcus *et al.*, 1998a,b).

The Stages of Change model has also been successfully applied to exercise in older adults [see (Nigg and Riebe, 2002) for a recent comprehensive review of the literature]. For example, Barké and Nicholas demonstrated that the Stages of Change model effectively differentiated between active and inactive older adults, and that it was applicable to the older adult population (Barké and Nicholas, 1990). Hellman studied stages of change in older adults discharged from a cardiac rehabilitation program (Hellman, 1997). Courneya *et al.*'s

research supported the Stages of Change model and found that Theory of Planned Behavior constructs differentiated and successfully predicted the stages of change in older Canadian adults (Courneya *et al.*, 1995, 1997, 1998). Gorely and Gordon provided evidence that supported the application of the TTM across age groups in the exercise domain (Gorely and Gordon, 1995). Additionally, intervention research by Marcus *et al.* has demonstrated the effectiveness of the TTM in motivating adults (including some older adults) to engage in exercise behavior (Marcus *et al.*, 1998a,b).

With regard to nutrition behavior, fruits and vegetables are so important for health that specific dietary goals and food guidance systems have been developed to increase their consumption (US Department of Health and Human Services, 1991; US Department of Agriculture, 1992). National campaigns such as 5-A-Day have increased awareness of the importance of these foods for health; however, research has indicated that fewer than 40% of persons over the age of 60 consume this recommended number of daily servings of fruits and vegetables (Krebs-Smith *et al.*, 1996). In a study assessing stages of change for fruits and vegetables in a large HMO sample, adults 65 years of age and older reported an average serving of three fruits and vegetables daily, which was higher than the approximately 2.5 servings reported by younger adults. Although older adults were more likely to be in maintenance than younger adults, only 26% of older adults were in action or maintenance for consuming five or more servings of fruits and vegetables a day (Greene *et al.*, 2001). As part of the earlier pilot research work for the SENIOR Project, instruments were developed for assessing processes of change, decisional balance and self-efficacy for consuming five or more servings of fruits and vegetables a day (Greene *et al.*, 2001; Rossi *et al.*, 2001).

Individual tailoring on a stage basis

A second reason for choosing the TTM is that it is well suited to developing individually tailored interventions, a dimension of the model related directly to its demonstrated efficacy. A tailored

intervention approach ‘custom-fits’ message content to each individual within a targeted group based on individualized assessment along variables believed to be important in the behavior change process. Individual tailoring consists of feedback supplied for all salient constructs of the TTM for each stage. Within each stage the individual receives feedback based on her/his process, self-efficacy and decisional balance levels compared to norms. Follow-up reports supply normative (compared to peers in the same stage who progress the most, based on earlier pilot research) and ipsative (based on current and previous responses from the individual) feedback. The delivery of this type of feedback is through an ‘expert system’ (Velicer *et al.*, 1993; Nigg *et al.*, 1999; Marcus *et al.*, 2000).

Expert system interventions mimic the reasoning of human experts by basing their feedback on decision rules. These decision rules are predetermined either by qualified professionals or by statistical procedures. An expert system contains a series of feedback sections based on the constructs deemed important for behavior change. Assessment of the variables provides the necessary data for the computer expert system to produce individualized feedback reports for both the normative and the ipsative components. This type of system allows for a large number of individual feedback possibilities (paragraph combinations). About 300 different feedback variations are possible at baseline and this increases exponentially to about 19 000 potential combinations in ipsative feedback reports.

Technological features

Another important reason for choosing the TTM as the theoretical framework for the SENIOR Project is a more practical consideration: its association with technology that allows for an individually tailored intervention to be disseminated to large, community-based samples. Thus, the ‘reach’ of the intervention is substantially greater than smaller, more clinically based interventions and therefore there is a greater potential for public health applications (Glasgow *et al.*,

1999). This is achieved through a distribution system that involves using mail or telephone to collect data to inform the intervention, which is communicated in the same way (usually through the mail) and does not require direct person-to-computer contact. This type of system has the advantage that it requires only a single central computer and peripherals (e.g. technological support area, data conversion and processing program) to serve everyone. Also, participants can be contacted at home regardless of whether or not they have a computer.

Interdisciplinary research base and community partnership

A final consideration in choosing the TTM was the availability of a strong interdisciplinary research base and team at the University of Rhode Island (URI), and the existence of a supportive community partnership. Increasingly, funding agencies are emphasizing the importance of research conducted within an interdisciplinary framework, especially with respect to problems demanding the perspectives of several different fields or disciplines. In the case of the SENIOR Project, the availability of researchers with backgrounds in exercise science, nutrition, psychology, nursing, pharmacy, gerontology and public health contributed to an enrichment and expansion of the TTM into the two-behavior, older adult focus summarized earlier. This interdisciplinary pool of resources served to enhance, expand and extend the expertise of those affiliated with the SENIOR Project beyond that of a research team consisting primarily of a single discipline, such as psychology.

The SENIOR Project is based within the Health Promotion Partnership, an interdisciplinary research 'incubator' established at URI in 1996 with seed money from the University. Its purpose is to develop new health promotion research interventions in behavioral areas and with populations where there is a clear opportunity for the development of grant-funded research and intervention projects. The Health Promotion Partnership had already set into place a collaboration with governmental departments and human service

agencies (such as senior housing sites) that facilitated the recruitment of subjects through joint sponsorship of the study. This partnership was embodied in a Community Advisory Committee to provide advice on partnership-building and subject recruitment/retention strategies.

Translating the TTM into intervention

Translating the TTM, with at least 14 variables, into actual application consists of several components: expert system assessments and reports, newsletters, manuals, and coaching calls. These interventions have evolved individually and collectively over time with successive TTM research studies focusing on different health behaviors. Importantly, all components of the intervention are targeted on all four TTM dimensions—stages, processes, decisional balance and self-efficacy—thereby reinforcing the intervention 'message' and anticipated impact. The intervention components and schedule were designed to provide a sustained, intensive intervention over a 12-month period for a community-based older population. Therefore, newsletters were provided on months without other print material mailings. The telephone coaching calls were designed to insure that individuals with deficits in processing printed materials in English—whether due to limited literacy, visual deficits or language barriers—would receive a minimum dose of the intervention.

Expert system assessments and reports

Expert system reports based on stages of change provide individualized information about the use of processes, decisional balance and self-efficacy. As discussed earlier, reports provide normative (compared to peers in the same stage who progress the most, based on earlier pilot research) and ipsative (compared to an individual's previous scores) feedback. Ipsative feedback allows even small positive steps to be highlighted and reinforced, as well as providing specific directions for additional small steps that can lead to major progress over time.

For the SENIOR Project, TTM data collected

from participants by telephone interviewers approximately every 4 months are used to develop individualized feedback reports consisting of the relevant TTM variables. Not all variables are relevant for all stages. For example, the cognitive processes like dramatic relief (emotional arousal) and consciousness raising (increasing awareness), as well as the decisional balance scales, would be the focus of interventions for project participants in the precontemplation stage. The more behavioral processes like stimulus control (re-engineering) and counter conditioning (substituting), as well as self-efficacy, are more relevant for the later stages. The TTM specifies which variables are the most appropriate for each stage [see (Prochaska and Velicer, 1997) for a detailed discussion of stages and their corresponding processes]. The system described here assesses all the variables on each occasion but provides feedback only on the relevant subset.

The 4–5 page feedback report is divided into four sections (see Table I for sample items, including examples of normative and ipsative feedback paragraphs):

- (1) *Stage and decisional balance.* This section contains a description of the participant's current stage of change, and their pros and cons of changing behavior. The feedback describes the interpretation of the participant's stage, their behavior in relationship to the target (nutrition only), how their decisional balance compares to others and how they compare ipsatively with their last assessment.
- (2) *Processes of change.* This section provides feedback on the participant's use of up to six change processes, how they compare normatively on each process with self-changers who were most successful in progressing to their next stage and how they compare ipsatively with their own previous assessment.
- (3) *Self-efficacy and tempting situations.* This section describes the tempting situations that are the most dangerous for the individual and provides feedback on how to successfully avoid or build confidence to control and overcome those situations.

- (4) *Strategies.* This section describes strategies for taking small steps to progress to the next stage. The strategy section is based on material identified through the behavior change literature appropriate for each stage. The feedback report also refers participants to sections of the stage-matched self-help manuals.

Newsletters

Newsletters consist of stage-appropriate information for each behavior—conveyed in a conversational, engaging manner—and rely on community resources and references. For the SENIOR Project, newsletters contain concise, easy-to-read and attractive educational materials describing different stages of change and stage-appropriate suggestions and activities. Eighty-two separate newsletters have been developed for exercise and diet. Newsletters are mailed on a monthly basis, except for those months in which an expert system feedback report is provided to the participant.

Manuals

Manuals address processes and strategies of behavior change appropriate for each stage and include interactive activities. SENIOR Project manuals focus (individually) on increasing exercise behavior and the consumption of fruits and vegetables among the older adult participants. Manuals are organized by stage and then by strategy within each stage. The stage-tailored manuals provide a ready reference for individuals who are changing faster or slower than the scheduled contact rate. Importantly, each manual has a list of community-based resources and programs, making them more community specific and thereby underscoring the community basis of the intervention. Manuals are provided in a three-ring binder, in which the participants may also place their expert system reports and newsletters.

Coaching calls

The expert system reports and other program materials are enhanced, integrated and personalized by telephone calls provided by a personal behavior change coach trained in brief motivational

Table I. *Sample items from expert system reports*

Stage of change/decisional balance

Precontemplation for fruits and vegetables:

You are not ready to change your eating habits right now. You have no plans to increase the number of servings of vegetables and fruits in your diet to the recommended five servings a day.

Unlike other seniors, you do not think very much about the health benefits (pros) and problems (cons) of eating more vegetables and fruits. You probably have many good reasons for not changing your eating habits. You may not think that eating vegetables and fruits will help you.

Have you thought about these pros?

- *Vegetables and fruits can cut down on constipation*
- *Vegetables and fruits help prevent diseases like cancer*
- *Vegetables and fruits are full of vitamins and minerals*

Make your own list of pros and cons of eating more vegetables and fruits. Think about how these foods might help you. Focusing on the pros will help you move forward.

Processes of change

Contemplation for fruits and vegetables:

Your feelings count...

You are not influenced much by the experiences of people whose eating habits have hurt their health. Take a few minutes to think about someone you know or have heard about whose health problems might have been prevented if he or she ate more vegetables and fruits. Think about the health problems that this person has. Reminding yourself of these stories may move you emotionally and help you in your decision to begin making changes in your own diet.

Look in the mirror...

Compared to others, you do not appear to think much about how your eating habits affect your health. Ask yourself if changing the way you eat would help you feel better about yourself and help you feel like a healthier person. Small changes could lead to a new, healthier you.

Self-efficacy and tempting situations

Action for fruits and vegetables:

Like others who have been successful at making changes, you have confidence that you can continue to include five servings of vegetables and fruits a day in your healthy lifestyle. Being able to eat enough vegetables and fruits, even when you are busy or away from home, will help you maintain your healthy lifestyle.

Strategies for change

Action for exercise:

You may find it hard to start exercising regularly. Fortunately, making exercise a regular part of your life gets easier with time. Focus on strengthening your commitment to exercise by including physical activity in your everyday life. Before you know it, exercising daily will be second nature and you will have successfully maintained an active, healthy lifestyle for a long period of time.

In the next few weeks, you may find you want to skip exercise sessions or stop exercising all together. This is normal! Use the following ideas and methods to help you stop those feelings:

- *Remind yourself of the benefits of regular exercise*
 - *Think of exercise time as your own special time to relax and enjoy yourself*
 - *Ask your close family and friends to encourage you to keep exercising regularly*
-

Transtheoretical Model (TTM) of Health Behavior Change

- Stages of change
- Processes of change
- Decisional balance
- Self-efficacy

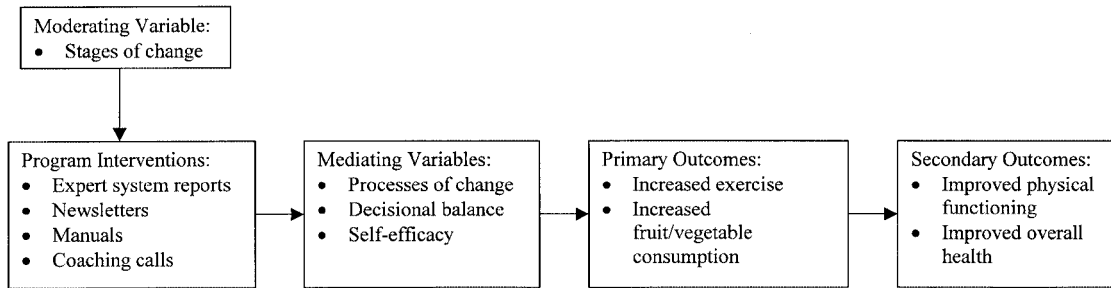


Fig. 1. SENIOR Project intervention effect model.

interviewing strategies (Rollnick *et al.*, 1992) employed in a stage-matched manner. The coaching calls are consistent with both the method of brief motivational interviewing and the TTM in that the goal is to enhance motivation for change by assisting the individual in resolving ambivalence, and by matching the style and content of the call with the person’s degree of readiness for change. The tone of the interaction style is positive, encouraging, empathic and non-confrontational. Providing information and advice is generally avoided unless solicited by the individual, which is often the case for those in the preparation, action and maintenance stages. The goal is to maintain a systematic, replicable approach while allowing flexibility to permit the coach to meet the individual needs of the participant.

Intervention effect

The TTM postulates that individuals who change their health-related behavior move through a set of stages of readiness for change. Depending on which stage the older adult participant is in, the intervention components (i.e. expert system assessments and reports, newsletters, manuals, and coaching calls) are designed to impact certain stage-appropriate processes, decisional balance and/or self-efficacy. Although the intervention

addresses all three constructs, it is possible that appropriate process use may have an additional positive effect on decisional balance and/or self-efficacy.

Progress through the stages is made through processes of change. Ten processes of change have been identified as strategies used most frequently and most successfully by people as they move through the stages. The 10 processes are divided into two higher-order factors representing experiential (where relevant information is generated by an individual’s own actions or experiences) and behavioral (where the information is generated by environmental events and behaviors) processes of change. The TTM proposes integration of the stages of change with the processes of change, self-efficacy and decisional balance. The stages represent a temporal dimension describing when cognitive and behavioral changes occur. The processes of change describe how these shifts occur. Decisional balance focuses on the benefits (pros) and the costs (cons) of a behavior, and is thought to be important in decision making and, hence, in behavior change. Self-efficacy involves a judgment regarding one’s abilities to perform a behavior required to achieve a certain outcome and is also believed to be critical in behavior change.

The change in the TTM constructs will facilitate adoption and maintenance of exercise and/or

increased fruit and vegetable consumption (depending upon intervention condition). The timing of assessments at baseline, at the end of the 12-month intervention, and again at another 12 month time point following the end of the intervention will also help to assess the duration of the intervention effect. Finally, given previous research on the effects of exercise and increased fruit and vegetable consumption on health outcomes in older adults, it is postulated that adopting the healthy behaviors will positively influence physical functioning and overall quality-of-life (see Figure 1). The research design will, importantly, allow for an examination of the effects and interrelationships of a two-behavior intervention.

Contribution

The SENIOR Project, based on the proven efficacy of the TTM in changing health-related behavior, is one of the first research studies to test the efficacy of multiple compared to single-behavior change interventions in older adults. It will provide important information not only on outcomes, but also on the process of behavior change in older adults. The development of the TTM-based intervention has already yielded new insights into how an older adult population may be different from that of younger adults and provided the basis for developing new stage-tailored materials for this population.

Additionally, the SENIOR Project relies on a community-based recruitment and partnership model, utilizing a public health approach to an entire population. This method of recruiting project participants differs from other TTM-based research studies in which subjects are recruited from such target populations as HMOs or an entire state through such means as random-digit dialing. The recruitment approach incorporates reliance both on ‘top down’ methods—such as newspaper ads and television programs—and on ‘bottom up’ approaches—such as offering informational programs at community sites (e.g. senior centers, housing projects, churches, supermarkets, and

pharmacies) and networking with informal systems and groups (e.g. friends and neighbors).

Thus, for a variety of reasons, the SENIOR Project represents a unique and innovative approach to health promotion with older adults. Its results hold the potential for developing new methods to substantially improve the health and well-being of this growing population, gain new and important insights into how older adults change their health-related behavior, contribute to an understanding of the impacts of multiple as compared with single-behavior interventions, and develop new methods of community-based recruitment. Although based on the substantial research already done with the TTM, the SENIOR Project promises to extend and enhance our knowledge of effective health promotion in several fundamentally important ways.

Acknowledgements

This research is supported by grant 1R01AG16588 from the National Institute on Aging, National Institutes of Health.

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Received on February 14, 2001; accepted on May 22, 2001