The effects of self-efficacy in bifurcating the relationship of perceived benefit and cost with condom use among adolescents: A cusp catastrophe modeling analysis

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ABSTRACT

This study tested the complex relationship among the perceived benefit from and cost of condom use, self-efficacy and condom use among adolescents as a nonlinear dynamic process. Participants were 12th graders in public Bahamian high schools who reported having had sex and frequency of condom use. Results revealed that the perceived benefit and perceived cost as asymmetry variables were significantly associated with condom use ($p < 0.001$) after controlling for covariates. The association was bifurcated by the variable self-efficacy ($p < 0.001$). Furthermore, the cusp model was better than linear and logistic regression models in predicting the dynamic changes in condom use behavior, judged by the AIC and BIC, and R^2 criteria. These results suggest that adolescent condom use may follow a nonlinear rather than linear dynamic process. Emphasizing bifurcation variables such as self-efficacy that promote sudden change could be essential to strengthen current evidence-based intervention programs in encouraging condom use.

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1. Introduction

Considerable public health effort has been devoted to the protection of adolescents from negative sexual and reproductive health outcomes, including unexpected pregnancy, sexually transmitted infection (STI) in general, and the spread of HIV/AIDS in particular (Leichliter, Seiler, & Wohlfeiler, 2016; Stanton et al., 2015; Wang et al., 2014). One of the best available methods to prevent sex-related negative consequences is condom use. Although condom use has many proven benefits, nearly half of adolescents and young adults did not use a condom during casual sexual encounter (Kann, 2016). Adolescents continue to be at high risk for HIV infection, STDs, and unintended pregnancies (CDC, 2015a, 2015b; Hamilton, Martin, Osterman, Curtin, & Matthews, 2015).

Although multiple studies have been conducted to investigate factors related to condom use, most of these studies are guided by a continuous behavior change model (CBC) (Chandran et al., 2012; X.; Chen, Stanton, et al., 2010; Y.; Xu et al., 2013). With CBC, changes in condom use behavior are assumed to follow a linear and continuous process governed primarily by logic

thinking and rational decision-making (X. Chen, Lunn, et al., 2010). However, human behaviors are more complex and a majority of our behaviors can be better characterized as a nonlinear dynamic process (X. Chen, Lunn, et al., 2010; Yunan Xu & Chen, 2016). For example, not all adolescents with adequate HIV knowledge will use a condom during sex; while many adolescents who consistently use a condom during sex do not have adequate HIV knowledge (Ochieng, Kakai, & Abok, 2011). Therefore, this nonlinear dynamic process will be missed if data are analyzed with CBC-guided method such as linear and logistic regression and conclusions generated from these studies can be misleading. In addition to preventing us from correctly understanding condom-use behavior, findings from CBC-based analysis will misinform evidence-based interventions to promote condom use and other related health behaviors (D. D. Chen et al., 2014; X. Chen, Stanton, Chen, & Li, 2013; Noar, Black, & Pierce, 2009; Wu, Stanton, Li, Galbraith, & Cole, 2005; Xiao et al., 2014).

To overcome the limitation of CBC-based modeling analysis, researchers have explored application of models and methods based on the nonlinear dynamical systems theory (Guastello & Gregson, 2011). Catastrophe theory is a subset of nonlinear dynamical systems theory and has been increasingly applied as guidance to characterize health-related behaviors. Typical examples of nonlinear systems dynamic model include successful cusp catastrophe modeling of alcohol use (Witkiewitz, van der Maas, Hufford, & Marlatt, 2007), cigarette smoking (Yunan Xu & Chen, 2016), sex initiation (X. Chen, Lunn, et al., 2010), and intentions to use condoms during sex (X. Chen et al., 2013).

Cognitively, the nonlinear dynamic characteristic of health-related behavior can be explained by the Dual Process Theory (Kahneman, 2003). According to the theory, decision-making to engage in a behavior is processed by two different systems — System 1 and System 2. System 1 is characterized by an intuitive, implicit, and automatic process. Behaviors processed through System 1 occur quickly and decisive without hesitation. Therefore, such behaviors will manifest as sudden and discrete. In contrast, System 2 regulates behaviors and decision-making process through detailed analysis and explicit reasoning. Therefore, the process is characterized as a gradual, controlled, and continuous process (see Fig. 1). It is worth noting that one behavior may be processed by one system in one situation and by another system in another situation. It is this dual process that consists of the nonlinear complex system dynamics.

Adolescence represents a period with imbalanced physical and cognitive development (Blair & Raver, 2012; Choudhury, Blakemore, & Charman, 2006). Therefore, most behaviors among adolescents are sudden and impulsive, suggesting the dominant role of System 1 in behavioral decision making. Findings from published studies demonstrate the nonlinear discrete nature of many health risk behaviors in adolescents, including cigarette smoking (Yunan Xu & Chen, 2016), smoking cessation (DiClemente et al., 1991), alcohol use (Witkiewitz et al., 2007), sexual initiation (X. Chen, Lunn, et al., 2010), and intentions to use condoms (X. Chen et al., 2013). Additionally, adolescence is a period for sexual development and exploration (Choudhury et al., 2006). Therefore, the decision process for adolescents to engage in sex and condom use might be dominated by System 1 with limited involvement of System 2, forming a mixed process of many intuitive sudden changes, plus a few gradual and continuous changes — a typical nonlinear dynamic process.
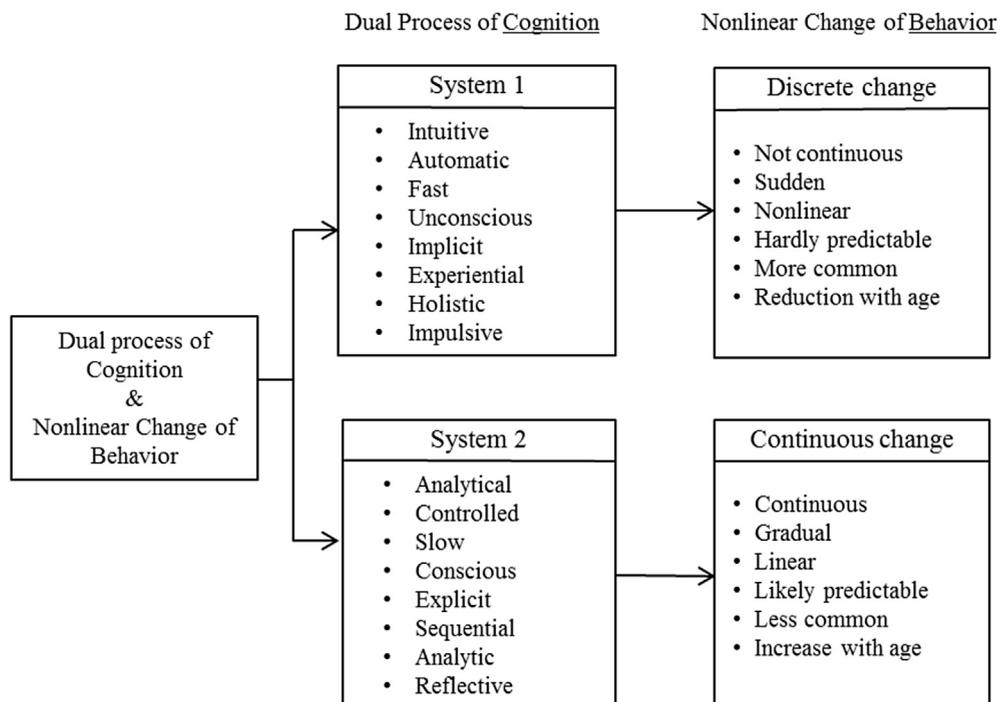

Fig. 1. The dual process theory of cognition and nonlinear nature of behaviors.