Psychology

Conscious-Nonconscious Processing Explains Why Some People Exercise but Most Don't

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Although it is well established by physiologists that exercise is the single best thing individuals can do for their health, most people are not regular exercisers. This failure poses an interesting but important question and challenge for psychological science. Why lack of success? Clearly, exercise is more a cognitive than physical battle. This paper reviews research from cognitive neuroscience to social psychology and proposes a theory in the form of a 3-stage model to explain why some succeed but most fail to become regular and habitual exercisers. The model elucidates how beginners, if successful, will progress on a continuum from fully *conscious processing* and little exercise (First Stage) to largely *nonconscious processing* and regular exercise (Third Stage). However, most beginners cannot get past the Second Stage, *conscious-nonconscious-conscious* (occasional exercise), and therefore fail to reach the third stage where this behavior is mainly driven by situational and contextual cues. This failure is reflected in findings that most beginners cannot get through five weeks without a lapse. The major obstacle in the second stage emanates from the combination of activated interdependent psychological processes: the human tendency to follow the law of least effort, especially after self-control depletion from daily work, and threats to personal freedom. Exercise can only be understood in the temporal and social contexts associated with leisure time when most people are most likely to be able to engage in exercise activities. It is in this context that the interconnected conscious and nonconscious processes are activated. The ensuing battle within and between these processes prevents most beginners from moving to the third stage and regular exercise.

Conscious-nonconscious processing | Exercise | Self-control | Freedom

INTRODUCTION

Lifestyle is the most important determinant of human health. For example, of the ten leading causes for years of potential life lost before age 65, lifestyle is estimated to account for 53%, followed by environment (21.8%), human biology (16.4%), and the health care system (9.8%) (1). For most people, lifestyle is controllable and centers on four key health behaviors: regular exercise, non-smoking, healthy diet, and moderate alcohol use. If people followed these health behaviors throughout their lives, they would live, on average, seven years longer (2). Statistically, physical activity contributes five years to this expanded lifespan (e.g., 3-4). In contrast, if cancer were eliminated altogether the lifespan would be extended only by two years (2). A recent review of over 30 years of physiological research (5) concluded that exercise is "the single most important thing people can do to improve or maintain their health". Regular exercise cuts premature mortality and heart disease in half, linearly decreases the likelihood of stroke with increased frequency and intensity of participation, reduces the probability of various forms of cancer, and helps eliminate diabetes altogether (6-9). Exercise has also been found to be at least as effective as pharmacological medications for reducing depression (e.g., 10). These health outcomes are possible because of the strong effects of exercise on the human body at cellular and molecular levels (11).

Against this background, assuming that health is important to people, one would think that everyone would be a regular exerciser. Yet, only 22% of the U.S. population exercise regularly, with 78% being either non-exercisers (24%) or "occasional" (54%) exercisers (6); exercise rates have remained stagnant for decades (12-13). This pattern presents an interesting and important problem for science, psychological science in particular. Why does the majority not engage in this health behavior? Although the role of environmental factors has been investigated, observed effects have been marginal at best (e.g., 14). Similarly, knowledge of exercise and its benefits make little or no difference in initiation or maintenance of exercise behavior (15-17). However, none of this is surprising to psychologists given that enactment of behavior always emanates from the processes of human mind. Even if people knew of the benefits of exercise and were surrounded by alluring outdoor environments, they would not exercise unless they could bring themselves (their conscious and nonconscious minds) to do so.

The purpose of the present paper is to review relevant research in an effort to help us understand why some succeed but most fail to regularly engage in this important health behavior. In doing so, the paper first provides a general theoretical framework (Figure 1) and then a more specific theoretical model (Figure 2) to account for psychological processes in initiation and maintenance of exercise behavior. Although this theory-building is based on empirical research, much work remains to be done to verify the offered explanations and models. For example, while we know the dominance of conscious control attempts and their neural basis in early exercisers, it is empirically unclear why most beginners fail to get past the first five weeks without a lapse. Is this a failure in conscious self-regulation or neurological processing, or both? This paper provides a theoretical explanation for this and other unanswered questions to stimulate future research. In doing so, it affirms the general argument that science advances not by the statistical testing of the null hypothesis but by theory construction and model expansion (154).

For clarity, nonconscious processing refers to mental operations (e.g., feelings and thoughts) of which a person is unaware. They are fast, automatic, associative and effortless (18); these "reflective reactions" (19) can affect all psychological processes with respect to perception, motivation and behavior. In conscious processing, in turn, attended information enters cognitive awareness and is reportable to others; it can be pondered and reoriented (20). When behaviors become routine and automatic with little or no conscious awareness, they grow habitual. Emerging habits are "chunks" of neural activity located in the specific regions of the brain (21).

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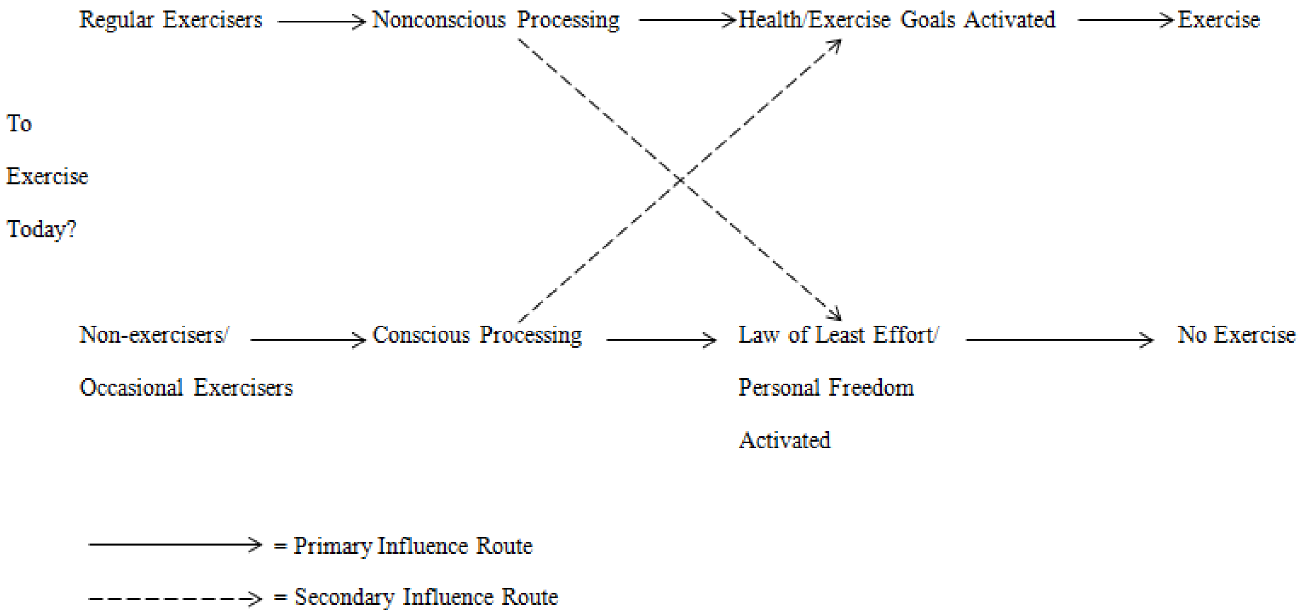

Figure 1. Conscious – nonconscious processing and exercise.

According to the general theoretical framework, when faced with the question whether to exercise today (Figure 1), 22% of the population does not have to think about it as the positive answer is provided by situational cues and associated nonconscious processing. To be sure, they can lapse occasionally, but their "primary" response is to exercise today. In contrast, the question elicits conscious thinking among the 78% group and activates formidable obstacles, of which threats to a sense of personal freedom and the general human tendency to follow the "law of least effort" are foremost. As a result, their "primary" response is not to exercise, although they may occasionally be able to overcome these barriers and thus get engaged in physical activity.

The paper proceeds to elucidate this overall process by presenting a 3-stage model to explain how the initiation and maintenance of exercise participation moves from early conscious deliberations to later nonconscious processing, and shows why most people cannot get beyond the second stage. In so doing, it proposes a psychological mechanism that sheds light on how nonconscious processing activates health- and exercise-related goals and resultant continued participation among regular exercisers, but not until the third stage. In contrast, conscious processing is fully responsible for initial engagement and experimentation in exercise activities during the first stage. However, this conscious processing likely activates feelings of threat to personal freedom ("exercise-or-else") and the human tendency to follow "the law of least effort" in occasional/non-exercisers. The second stage becomes the battleground where both conscious and nonconscious processes face the formidable task of facilitating regularity of participation. Unfortunately, research indicates, most people lose the battle and therefore fail to move to the third stage of sustained engagement.

MADE TO BE ACTIVE

Human mind and body were made to be actively used. The associated principle of "use-it-or-lose-it" means that many aspects of the human machinery deteriorate with lack of use, or in reverse, grow with use, as evidenced by various scientific findings. For one, recent research has shown that lipoprotein lipase (LPL) plummets in the blood stream when people do not move at all but sit all day long (22). As a consequence, the reduced LPL cannot break cholesterol and thus increases the likelihood of heart disease by 54%, with sitting becoming an independent risk factor for it (23). For another, there have been several case studies reported according to which young people have developed deep venous thrombosis (i.e., blood clots) after playing videogames nonstop for 7-8 hours, and as a result, some have died from pulmonary embolism (24).

A different line of research has indicated that bone density is increased with exercise and decreased in its absence (25), and it is well known that astronauts experience skeletal muscle atrophy if unable to engage in weight-bearing exercises in weightlessness (26). Perhaps the most visible consequence of the "use-it-or-lose-it" principle is today's obesity crisis (use-it-or-gain-it), which has much to do with the "epidemic of physical inactivity" (7, 27). Finally, to all of this evidence, one should add a long line of research on the effects of stimulus deprivation on the human brain, mind and the central nervous system (28-29). For example, even as early as the 1950s, it was reported that orphanage children who had no environmental stimuli (but were given adequate nutrition and fluids to survive) suffered from dramatic locomotor retardation. It took two years for these children to be able to sit by themselves and four years before they were able to walk (30-31).

Research supporting the positive impact of the use-it-or-lose-it principle has shown that physical activity and active use of one's mind confer important neural and cognitive benefits (i.e., enhanced neuroplasticity and neurogenesis). Learning new motor skills or rehearsing one's skills in them increases the brain's gray matter (32), while effortful and successful learning keeps new neurons alive (33). Physical activity increases the size of hippocampus and thereby improves memory function (34), prevents impairment of executive function (35), facilitates creativity (36), and mitigates the negative effects of certain genes on cognitive performance (37). Furthermore, cognitive functioning has been shown to improve through regular participation in cognitive (38-39), physical (40-42), and social (43) activities. Regular participation in these activities builds the "neurogenic reserve" that protects against behavioral manifestations of the age-related cognitive decline (44). The net result is that regular participation in challenging activities is associated with reduced risk of dementia (45). In short, "neuronal adaptations result from being active during leisure time" (32, p. 12448) and are manifested in enhanced neuroplasticity and neurogenesis, all of which translates into a more efficiently running and better performing brain. But does this biological and psychological imperative for active lifestyle translate into rational thinking and doing what is the best for us?

Temporal and Social Contexts of Exercise

Before attempting to understand whether people do what is best for their health, it is important to keep in mind that exercise behavior can only be understood if it is analyzed as a leisure activity, in its temporal and social contexts (46-47). For most people, daily exercise has to be undertaken after work. It therefore becomes another leisure activity that competes with other activities for time and social resources, leading to a cognitive battle in the choice of activities. Herein is a major problem for would-be exercisers. Given that a sense of freedom is the defining characteristic of leisure (48-49), any violation of it leads to psychological reactance (50) and avoidance of any behavior that threatens that sense of freedom.

A problem with exercise is that it is promoted as a "do-it-or-else" activity, giving non-exercisers and occasional exercisers little or no sense of choice. Importantly, it makes them conscious thinkers who have to make hard choices, which is cognitively straining and generally avoided (18). Typically, when people come home from work, it is the first time during the day when they feel, "it is my time to do whatever I want", and therefore do not want to be told what to do (i.e., you have to go for a run) and engage in making difficult decisions. To a considerable extent, free time, of course, is an illusion because there are many compulsory activities that have to be done in leisure time, such as household chores and child care. Nevertheless, there is plenty of free time available in leisure for exercise as an average American finds five hours a day to watch TV (51). A critical psychological point, however, is that for occasional exercisers and non-exercisers, choosing to exercise is cognitively straining and undermines their sense of freedom, while other common leisure activities (e.g., TV watching) do not; many of them are triggered by situational cues and run by nonconscious processing (47), and are therefore not cognitively straining. Empirical evidence supports the idea that the exertion of cognitive (executive) control is neurologically costly or aversive (52). The result is that the law of least effort is followed while fulfilling the fundamental need for autonomy (53), making this principle a formidable obstacle for would-be exercisers.

This means that exercise, if perceived as a choice among other leisure activities, faces an uphill battle to become an integral part of one's leisure repertoire. Recent research from other contexts (54-56) suggests that important health-promoting behaviors such as exercise cannot be perceived and presented as choices to be selected from a host of leisure activities; rather, they are to be seen as activities that have to be undertaken regardless of conditions (46-47). A high commitment to one's exercise goals facilitates these perceptions as it suppresses the desire to restore a sense of personal freedom (57). In this view, then, exercise becomes a forced "choice", and self-identity becomes associated with the mere doing of the activity, but not with a sense of freedom or any of the benefits to be obtained from the exercise activity (58). Yet, such a forced but accepted choice to exercise allows people to maintain their general tendency to overestimate the role of consciousness and experience themselves as agents making individual decisions (59).

To further elucidate the role of freedom of choice, it is important to distinguish between temporary and permanent choices. Beginning exercisers see exercise as one activity (choice) among many other leisure activities and therefore continue to make a temporary choice to exercise or not to exercise on a daily basis (46). Conscious processing, therefore, is an essential part of their decision making. However, later with a sufficient number of repeats (60), some of these exercisers advance to the point where a permanent choice is made to exercise regardless of daily situations. Subsequently, this permanent choice eliminates temporary choices about exercise, as well as the permanent choice itself; exercise is simply done no matter what. Thus, the importance of personal freedom is significantly reduced, if not eliminated altogether, and the role of conscious processing diminished. Conscious processing is, of course, decreased with reduced perceived freedom because people do not think about the consequences of the elimination of freedom. In general, reduced conscious processing gives way to increased nonconscious processing, and therefore, to a greater likelihood that behavior will be repeated (19, 61-62). This repeating of nonconsciously triggered behaviors is manifested in the dominance of sedentary leisure activities, especially TV watching (47). It should be noted that although freedom generally is important to individuals, there are considerable cultural differences in the need for self-expression and choice (63-64). These differences suggest that in Asian cultures, for example, it would be easier to overcome the freedom problem associated with health behaviors, especially exercise.

Rational Thinking and Decision Making?

If people were rational thinkers and decision makers regarding their activity involvement, everyone would be a regular exerciser (assuming that health is important to them). They would reason, "I have time for a 30-40 min. run/walk and still four hours left to watch TV". They might also weigh the benefits and costs of their behavioral choices and would select a behavior with the most favorable cost-benefit ratio (65). If they were rational, they would also respond to perceived health risk by exercising. However, people do not make rational choices regarding health behaviors as reflected in the finding that the perception of risk is generally a poor predictor of behavioral change to reduce risk (66). If would-be exercisers were rational about their personal time use and health risk, they would become "self-as-doers" (58) concerning their exercise participation. People with this predisposition have been shown to engage in health-related behaviors regardless of daily circumstances and obstacles (58); they are not concerned with immediate rewards either. Compared to non-exercisers, exercisers do not engage in "temporal discounting" or a decision-making process according to which they would seek immediate gains; instead, they view long term healthy rewards as more important (153). The fact that 78% of the population remains sedentary suggests an absence of such rational reasoning, resulting in people not doing what is good for them (67-68). This apparent irrationality seems to be reflected in research findings suggesting that people rate TV watching among their worst leisure experiences, yet on average spend almost five hours a day doing it (69). Why would anyone do something for five hours a day if it is experienced so negatively?

Research suggests that "people are unable to resist spending more time in this activity (TV watching) than they would consider healthy or desirable" (70, p. 49). Wouldn't rational decision-makers be able to resist it? The fact that they do not may reflect the overriding influence of situational cues (e.g., the sight of TV itself) and the resultant strength of nonconscious over conscious processing (62, 71-72). Consistent with this, it has been argued that leisure is an incubator for automatic processes and a difficult setting for the conscious mind to override the influence of situational cues (47). In other words, because leisure is their personal time, people tend to avoid difficult conscious decisions (e.g., Should I exercise today?), but instead, answer easier ones (e.g., Will I watch my favorite program on TV tonight?) without conscious awareness. Giving up on conscious thinking and letting the nonconscious mind run unopposed poses a formidable challenge for non-exercisers and occasional exercisers during their leisure time, but helps us understand why people often do not do what is good for them. More generally, "the ease with which people are satisfied enough to stop thinking is rather troubling" (18, p. 46).

The tendency not to do what is in one's best interest is not limited to just health behaviors. It has been demonstrated (73) that emotions can have powerful effects on financial decisions. Experimentally induced emotions carried over from a prior, irrelevant situation to another situation and negatively affected study participants' selling and buying decisions. In a similar vein, wild swings in the stock market are known to make people emotional and irrational, leading them to "buy high" and "sell low" (74). "Loss aversion" means that losing evokes stronger negative feelings than winning elicits positive emotions (18). Furthermore, the median retirement savings of a family between 50 and 55 years old is just $8,000. Saving, of course, denotes delaying immediate gratification for greater future gains but is difficult in an environment where mere (nonconscious) exposure to symbols of the instant society activates impatience and leads to inferior financial decisions (i.e., non-saving) (75). These kinds of findings cast serious doubt on the "rational-agent" model of human financial behavior espoused by traditional schools of economics. According to this model, people make rational decisions as long as the relevant information is provided.

Behavioral economists (e.g., 76), however, have challenged this model in a fundamental way by showing that although people do not generally make rational financial decisions, they can be helped, guided and even protected in the process. For example, if employees are "nudged" to join a pension plan as a default option or if they allow their employers to tie a fixed proportion of their salary raises to a saving plan by default, the savings rate improves dramatically (76). It is interesting to note that such an automatic enrollment in a pension or savings plan takes the focus away from freedom to choose, akin to taking freedom of choice out of exercise behavior by designating it as a necessary activity that has to be done like teeth brushing in the morning. All of the above, however, raises a bigger question about whether people, when left to their own devices, can make rational choices about their health, finances and other matters, and whether others (and society) should intervene in the process and "nudge" them toward better decisions. The fact that 78% do not exercise regularly and 68% are overweight or obese suggests that they do not seem to be able to make conscious decisions that are in their best interest. Alternatively, situational cues and the associated nonconscious processing are so powerful that they override rational decision making.

CONSCIOUS-NONCONSCIOUS PROCESSING: 3-STAGE MODEL

Is it conscious or nonconscious?

Abundant empirical evidence accumulated during the last 20 years on the role of conscious-nonconscious processes (for reviews of research, see 18-19, 61-62, 77) provides a clear theoretical framework for answering fundamental questions about human behavior, such as, why do we choose to engage in certain activities but not in others (47)? Baumeister et al.'s (61) comprehensive and insightful review of research leaves little doubt about conscious thoughts' "profound" and "empirically strong" effects on cognitions and behaviors. At the same time, numerous experiments have shown that goal pursuit can run outside of cognitive awareness (62). Many prominent researchers (e.g., 18-19) have argued that in everyday life, people are "fast" thinkers most of the time; that is, their responses and decisions are mostly based on intuitive, impulsive, associative and automatic (nonconscious) thinking. Accordingly, they operate on a simple cognitive level, answering such questions as, what is 2+2?, but avoid the strain of "slow" thinking (17 x 34?). They are predisposed to stay away from cognitively demanding tasks and protect their pleasant affect by avoiding excessive mental effort (78).

It is not surprising that dual processing of cognitive activity (nonconscious vs conscious; System 1 vs System 2; Type 1 vs Type 2) has been discussed and argued at length (79-80). A recent vigorous debate for and against unconscious vs. conscious influences on cognitions and behaviors has divided researchers into two camps (81). This debate, however, misses the mark, because conscious vs. nonconscious processing is not an either-or-proposition. Both are present and needed, even if to varying degrees, for initiation and maintenance of human behaviors. There are no purely consciously driven activities and no purely nonconsciously guided activities. For example, even though it has been shown that watching library pictures triggers nonconscious processing resulting in people speaking more softly (82), it does not mean that they do this always and under all conditions. Even if situational cues become so powerful that they initiate certain behaviors through nonconscious processing, the conscious can readily interrupt habitual and automatic responses (e.g., 61, 83).

Laboratory research has provided strong support for the existence of nonconscious processing that can result in the automatic sedentary activity choice and participation noted above. However, when thinking of behaviors outside of laboratory (e.g., exercise) that do not involve millisecond responses on computer keyboards, does it really matter, as has been found, that nonconscious processing begins 1 second or more before movement when the conscious intention to act *also* starts before movement, even 206 milliseconds before the onset of muscle activity (84)? Such findings, aside from major methodological concerns (85), indicate that the brain's preparatory activity could begin a few hundred milliseconds before the conscious intention; however, these findings do not mean that intentions cannot intervene right before or after the onset of movement. In fact, there is plenty of evidence that conscious processing can override (86) and "veto" (87) nonconscious impulses, alter responses assumed to be immune to conscious control (88), and reduce the power of situational cues (89). In short, nonconscious automatic processes can be suppressed and altered by conscious intentions, which is important when considering everyday behaviors such as exercise.

Furthermore, there is no clear starting point or location for neural processing for motor movements, with the processing beginning in several places in the brain simultaneously and involving distinct cortical circuits (20). These circuits consist of loops rather than linear chains (90). The basal ganglia-presupplementary motor area circuit and the parietal-premotor circuit seem to play a key role in the process. There is also evidence that decision making and the motor preparation in the brain proceed in parallel (91). As the preparatory neural activity must itself be caused, the cascading neural activity does not begin randomly or appear magically from thin air, but instead, has its basis in social learning, past experiences, and others' behaviors in similar situations (92). It is clear, then, that both processes (conscious and nonconscious) are responsible for human behavior. An important unanswered question remains about the conditions (e.g., starting an exercise program vs. continuing an existing one) which give rise to and dominance over one another. An argument that "there is no role for consciousness" in human behavior (72) is, needless to say, misleading and theoretically or empirically unjustified. While no clear consensus exists on the dominance of conscious over nonconscious processing, or vice versa, it is indisputable that conscious mental events cause and drive behaviors (93). Baumeister et al.'s (61, p. 334) conclusion perhaps best summarizes the current state of knowledge: "It is plausible that impulses to act generally originate in the nonconscious, but behavioral outcome depends crucially on what happens when they are contemplated consciously". In light of recent experimental evidence (94), this is especially true for complex behaviors such as exercise.

What does all of this mean for exercise behavior? First, it suggests that both the conscious and nonconscious minds have to be involved in making people regular exercisers. "Necessity for the nonconscious and conscious mind to work together and complement each other underscores the fact that exercise is as much a cognitive as it is a physical challenge" (46, p. 104). Second, initiation and maintenance of any complex and demanding behavior operates on the continuum of conscious-nonconscious processing such that in the beginning, conscious processing dominates behavioral engagement but after countless repeats, nonconscious processing takes over and makes behavior habitual, thereby sustaining it in the long run. Based upon this general model, I propose a more specific model according to which there are three stages of exercise behavior (Figure 2) characterized by a varying degree of conscious vs. nonconscious processing, proceeding from fully conscious processing (First Stage) to predominantly nonconscious processing (Third Stage).

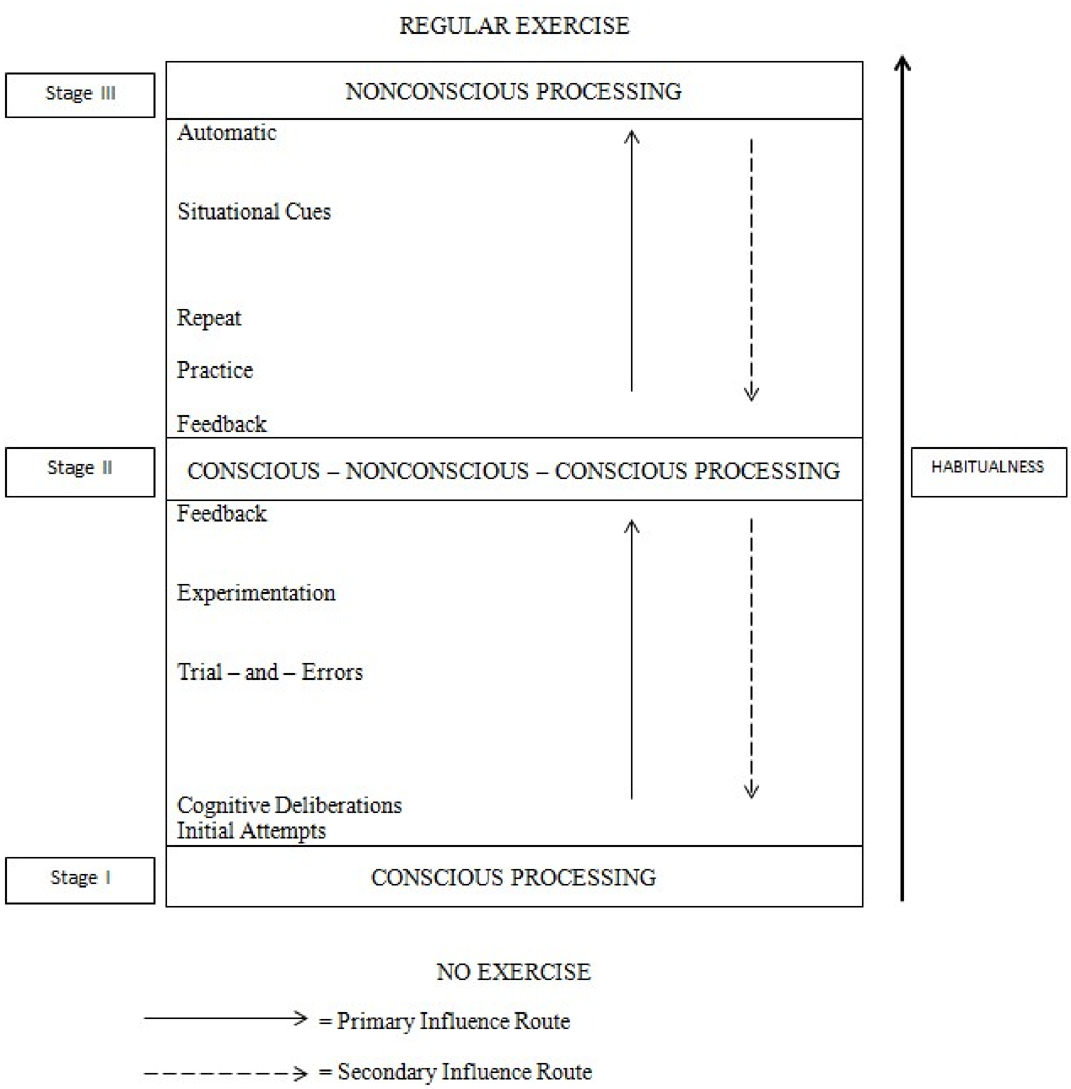

Figure 2. Three (3) Stages of Exercise.

FIRST STAGE: CONSCIOUS PROCESSING

In the first stage, *conscious-cognitive*, people for a variety of reasons become aware of the importance of exercise for human health in general and their own health in particular. Subsequently, they may take initial steps to find out *how*, *when*, *where*, and *with whom* they could exercise, thereby starting to build *exercise infrastructure* for their physical activity. Sooner or later, this information search leads to the first attempts to engage in selected forms of exercise. It is also likely to result in the establishment of goals for exercise participation. Research has shown that proximal, specific, difficult but attainable goals produce better results than vague "do-your-best" goals (95). Similarly, personally meaningful goals that "self-affirm" and are aligned with one's core values enhance self-control (96); such goals are linked with maintenance of health behaviors and yield significant health gains from them (97). The monitoring and elimination of goal conflicts, however, becomes important given the evidence that when desires for leisure activities (e.g., mass media) conflict with other activity goals, they bring about the most self-control failure (98). Physical activity goal progress can be increased by "action planning" but only if exercise goals do not conflict with other goals (99). Thus, monitoring discrepancies between goals and current behaviors is essential for self-control and goal achievement, and may explain why mindfulness improves self-control (100). All of this suggests that in the first stage, continuing to exercise is more a matter of cognitive effort and control, as well as conflict resolution, than actual competence with the muscle movements. Cognitive effort, in turn, is closely connected to engagement of the executive control network (101).

Research further suggests that goal conflicts can be pre-empted and managed by the systematic construction of exercise infrastructure. Gollwitzer (102) reported that compliance with participation in a vigorous exercise program was dramatically greater (39% vs. 91%) when specific "if-then" plans were employed compared to being exposed to a general motivational package (promoting self-efficacy, providing information about vulnerability to disease etc.). Such plans constitute the essence of exercise infrastructure and specify when, where, how, and with whom exercise will be undertaken; they in part determine whether beginners are able to move from dabbling in exercise to sustained attempts to benefit from physical activity. Regardless, everyone's engagement during this stage is driven and characterized by heavy conscious involvement and processing. Common experience tells us that people embarking on their initial exercise programs cannot do so without thinking hard about how, when, where and with whom to participate.

Conscious self-regulatory efforts, either by their presence or absence, play a key role in the first stage. Research has shown that self-regulation has a much greater effect on physical activity than other social-cognitive factors such as self-efficacy (e.g., 103). However, most beginners appear to fail in self-regulation as the proportion of people surviving five weeks without an exercise lapse is as low as 18.7% (60). This failure most likely reflects lack of participants' self-regulatory skills, such as goal setting, conflict monitoring and "self-affirmation". Further, people may have general intentions to exercise but no specific "action plans" for engagement. In fact, general intention is a relatively poor predictor of physical activity (104-105) and considerably worse than specific intentions in goal achievement (106). The role of intentions in exercise diminishes with increased habitualness, but grows with changes in stable environments and when habits are weak (83, 107). Given that habitualness is virtually nonexistent in the first stage, these findings support the idea that exercisers in the first stage rely heavily on conscious cognitive control to regulate their participation. Evidence suggests that the better self-regulation capacity, the more successful people are in converting intentions into physical activity (108).

In the first stage, conscious processing centers on two cognitive control tasks: (1) self-regulation of exercise behavior and associated cognitions (e.g., monitoring, self-affirming, evaluating) and (2) resistance or inhibition of competing behaviors and temptations. Evidence suggests that limited self-regulatory skills undermine efforts to consciously and cognitively control achievement behavior (109). Deficient self-regulatory skills also correlate with reduced capacity to control or inhibit temptations and impulses (110-111). Attempts to control temptations and competing habits are also undermined when self-control resources have been exhausted (112). It has been suggested that such depletion often occurs at work and subsequently spills over to leisure, weakening efforts to resist temptations (e.g., TV watching) in leisure when exercise is typically undertaken (47).

Research suggests that when people try to "balance" achievement goals and temptations, they tend to choose "first temptation, then the goal", resulting in the postponement of goal pursuit (exercise) in favor of instant gratification (113, 153). This research has shown that instead of "balancing", "highlighting" (or focusing on the primary goal) leads to employment of self-control strategies that block temptations. Similarly, research on "goal shielding" has shown that when people are highly committed to their primary goal, the mere activation of this goal "shields" them from conflicting goals and thus helps in controlling temptations (114). Such a strategy would seem to be important to exercisers in the first stage when they need to resist the power of temptations and the influence of nonconsciously processed cues for inactivity during leisure.

Cognitive control attempts for goal pursuit in general (115) and with respect to physical activity in particular (116) are underpinned by neural processes, specifically executive functions and working memory operations (101). It is unclear, however, which neuron networks underlie self-regulation of exercise behavior. But it has been established that the prefrontal regions and subcortical limbic structures of the brain are involved in reward detection in goal pursuit (117) and may therefore energize exercise behavior for those who perceive exercise as rewarding. The role these brain regions play in reward processing and effort recruitment for exercise remains to be determined.

In the first stage, an important determinant of self-regulatory success or failure is individuals' initial motivation for entering their exercise programs. Do people begin out of pure interest or felt obligation? It is well established that intrinsic versus extrinsic motivation influences cognition, affect and behavior (53). Other things being equal, the self-determination research suggests that intrinsic motivation leads to self-regulatory success and extrinsic motivation to self-regulatory failure. Recent research supports this general conclusion and indicates that initial motivation affects how temptations are experienced and resisted. More specifically, Milyavskaya et al. (118) found that people with "want-to" (intrinsic) motivation experienced fewer and weaker goal-interfering temptations, perceived fewer obstacles to goal pursuit, and exhibited stronger resistance to conflicting desires. By contrast, people with "have-to" (extrinsic) motivation perceived stronger temptations, greater obstacles, and lower control for goal-thwarting stimuli. Such individuals are also likely to engage in "temporal discounting", or making decisions that emphasize immediate gains and rewards (153).These findings are consistent with research indicating that self-control is most successful when attention is fully available to devote to the self-relevant task or activity (119). "Want-to" motivation likely enhances this attention to the activity.

These results suggest that motivation for starting exercise programs sets the stage for success or failure at subsequently maintaining physical activity. If people initiate participation with the idea of a "must", or "I should do it", they experience more and stronger temptations and are less able to resist them, with the net result of an increased likelihood of lapsing and quitting. In support of this idea, it has been found that framing exercise goals in an intrinsically motivating and autonomy-supportive way enhances long-term persistence in exercise activities (120). Self-determined motives also build habit strength (121-122) because they lead to more frequent repeats of the behavior. Growing habit strength, in turn, helps exercisers move onward to the second and third stages, where behavior becomes increasingly determined by nonconscious processing.

However, although conscious cognitive control processing is heavily involved in early exercise participation, conscious rational thinking in and of itself does not guarantee that most people become regular exercisers. Instead, success of continued engagement in the first stage seems to crucially depend on whether conscious thoughts are directed at building self-determined motivation, developing self-regulation and self-control skills and strategies, eliminating goal conflicts, and reducing the influence of temptations and competing habits.

SECOND STAGE: CONSCIOUS-NONCONSCIOUS-CONSCIOUS PROCESSING

The second stage, *conscious-nonconscious-conscious,* is the most important of all three. If participants can get past this stage to the third one, the battle for uninterrupted engagement has been won. Unfortunately, most people can never get past the second stage, as reflected by the repeated finding that about 54% of exercisers are "occasional" and 24% non-exercisers. If the first stage is characterized as putting one's toes in water, the second stage is equivalent to jumping in it. It is suggested that at this stage, participants experiment with different types of exercise, as well as frequency, duration and intensity of exercise. Accordingly, they practice new forms, repeat temporal patterns, and search for personally meaningful engagement. Through trial and error, new skills are learned and rehearsed in various ways and settings. Such experimentation is a reflection of cognitive control attempts and the heavy involvement of conscious processing.

At this stage, feedback plays an important role, whether in the form of the body's physiological response to various work-out programs or partners' and personal trainers' advice and social reinforcement. Competence feedback (i.e., success at exercise) enhances intrinsic motivation (123), and feedback on goal progress increases self-efficacy, with elevated self-efficacy in turn sustaining motivation and behavior (124-125). In the second stage, *exercise infrastructure* is further constructed and solidified. In other words, the infrastructure is formulated for when (*time management*), how (*format management*), where (*place management*), and with whom (*social management*) exercise is undertaken and performed. Without such a solid infrastructure, achievement of the third stage is difficult, if not insurmountable, because the foundation for the repeating of the behavior is otherwise absent.

Although no definite and precise starting and ending points exist for the second stage, this stage can begin in the first few weeks after initiation of an exercise program and end about six months later. In general, the third stage commences and the second one ends when exercise has become largely, or completely, habitual. Some studies (e.g., 60) suggest that it can happen as early as five weeks after the beginning of a program, depending on frequency and success of early exercise. If exercise does not become habitual by the end of six months, it is unlikely to become so later. By the end of the sixth month, at least one half of the participants have quit (126). The 50% drop-out rate suggests that these participants still struggle with conscious thoughts (e.g., "Should I exercise today"?). Ironically, they still need conscious thoughts for participation but these thoughts lead to quitting, because they prevent situational cues and nonconscious processing from becoming the main generator and sustainer of behavior. For them, conscious thoughts become an impediment for rather than a facilitator of continued participation.

The high rate of lapsing and quitting causes additional problems for conscious processing in the first two stages. Individuals who lapse or quit altogether after starting a program experience dissonant thoughts (46). Obviously, they could eliminate such thoughts by continuing their participation, but most people are unable to do it on their own; only about 19% survive the first 5 weeks without a lapse in participation (60). Unfortunately, from a behavioral perspective, the problem is that people can easily resolve dissonance by cognitive means or rationalizations. There are, however, ways to facilitate the behavioral resolution. Bator and Bryan (127) reported that when people were reminded about not living up to their own preaching (i.e., they were hypocrites), they subsequently used the fitness center far more frequently than participants who were not made feel hypocritical. By living up to their commitments and pledges, participants avoided feeling dissonant and hypocritical, thereby resolving dissonance by behavioral means. Similarly, making a commitment to exercise through a signed contract has been shown to have positive long-term effects on workers' exercise behavior (128). Such commitments allow people to pre-empt or eliminate dissonant thoughts about exercise, which consequently helps them maintain the activity in a long run. Nevertheless, since lapsing or quitting occurs among most participants (60), dissonance is inevitable and reflects the difficulties cognitive processing faces in efforts to relegate exercise to nonconscious processing.

The second stage is characterized by both conscious and nonconscious processing. Although conscious processing is still dominant, especially in early phases of this stage, theoretically, nonconscious processing becomes stronger with time and more frequent repeats of exercise behavior. Exercise grows more habitual with each repeat because it can increasingly be primed by situational cues, such as the time of the day, the sight of exercise gear or other exercisers. The role of conscious and nonconscious processing in this stage can be likened to a person learning to ride a bicycle. Although the conscious is heavily involved in early phases of learning the skill, increased success at pedaling and balancing the bike reduces the role of conscious processing and enhances that of the nonconscious. However, wobbling movements when biking quickly activate the conscious mind to become involved in the process to take over the execution of minute parts of the skill. The back-and-forth between conscious and nonconscious processing goes on till the skill is firmly entrenched neurologically (91) and behaviorally (61, 83). When this level is achieved, behavior and skill execution become primarily driven by the nonconscious. At that point, attention and conscious processing are freed up to attend to other internal thoughts or feelings, or other incidental happenings in the external world when biking.

So it is with exercisers in the second stage. There is back-and-forth between conscious and nonconscious processing. The critical difference, however, is that participants' decisions regarding exercise continue to be strongly influenced by conscious processing (e.g., "Should I exercise today"?), even if they are making progress toward nonconscious processing. Nonconscious thinking cannot become dominant if the behavior is not repeated frequently enough; situational cues have to become strong enough to elicit actual behavior, not just relevant goals (94). This is evident in case of "occasional" exercisers. When they occasionally exercise, these exercisers' engagement has to be initiated and maintained by conscious processing each time. Paradoxically, conscious processing, which is supposed to promote rational thinking and active participation, brings to one's mind difficult questions (e.g., "Why should I sacrifice my personal time and freedom for yet another obligatory activity"?), and in doing so, blocks frequent participation and the nonconscious from becoming dominant; exercise habituation does not grow as long as conscious processing is in charge. Evidence indicates that on days when intentions are strong, habit strength does not predict physical activity (107), suggesting that conscious thoughts undermine habit development and associated exercise behavior. For "occasional" exercisers, nonconscious priming of health-related goals is not enough to trigger actual behavior on a regular basis (46-47, 94). Using the bicycle analogy, they have not learned the skill sufficiently well and therefore cannot relegate it to the nonconscious; the net result is that they remain "occasional" exercisers. Only 22% of the population has been able to get through the second stage to the third one and thereby become habitual exercisers (as described below).

Three Psychological Processes

The second stage is the battleground mainly within rather than between conscious and nonconscious processing. While both are deployed to promote exercise participation, paradoxically they also resist exercise from becoming a regular behavior. This resistance stems from the interdependent influence of three psychological processes: (1) the general human tendency to try to achieve goals with the least amount of effort (18, p. 35), (2) self-control depletion during a day's work and/or other activities (129-130), and (3) reactance to possible loss of a sense of personal freedom (50). The first leads to the avoidance of demanding cognitive and physical activities in general, and thus the selection of the least demanding course of action to achieve a goal. Tasks and activities that require either cognitive or physical effort are shunned because people expend effort only when they need to (131). The search for the path of least resistance is also seen in people's tendency to substitute vitamin pills for exercise, an obvious attempt at a shortcut for health (132).

Second, coinciding with the tendency to follow the law of least effort, depletion of self-control resources (129) during a day's stressful work leaves people with diminished mental strength to be harnessed for engagement in demanding physical activity during their leisure on one hand and to resist temptations for involvement in non-demanding activities (e.g., TV watching) on the other (46-47). The empirical evidence suggests that the more recently and frequently people have resisted their earlier desires, the less successful they are in their subsequent attempts to resist or control other desires (98). "Ego depletion" also leads to reduced pain tolerance, less persistence, and lowered delay of gratification (96), all of which means it is difficult for conscious processing to make demanding exercise activities become regular daily behaviors.

It should be noted that experimental studies on self-control depletion have recently been criticized for a lack of consistent findings across laboratory tasks (133). The validity of this criticism, however, is questionable for several reasons. First, the fact that ego depletion does not appear to occur in all kinds of laboratory tasks may have more to do with artificial tasks performed in artificial ways (e.g., quick sequential performance of a second task) in artificial settings, rather than a failure to find support for the existence of the phenomenon itself. Second, like any other psychological phenomenon, self-control failure (due to previous use of self-control) cannot be expected to be a universal phenomenon that occurs everywhere all the time; that is, there are conditions under which it is more likely to materialize. It is the task of empirical research to discover such conditions (154). Third, as Baumeister (129) and others have indicated, self-control can also be strengthened with judicious use, similar to working on different muscle groups on different days. Fourth, and most importantly, when thinking of everyday work-related behaviors and leisure activities (e.g., exercise) in a longer-term sequence, self-control depletion is more likely to be a real phenomenon, as indicated by Hofmann et al.'s (98) findings. For example, compared to a quick sequential task performance in a laboratory, spending 8-9 hours at work, and engaging in self-regulation and self-control during most of this time, is much more likely to produce the depletion effect subsequently in leisure, especially in regard to such demanding leisure activities as exercise (47).

But even such depleting conditions of work are not likely to lead to self-control failure in leisure among everyone. Iso-Ahola (47) theorized that 22% of the population (regular exercisers) may actually use self-control depletion at work to their advantage by "compensating" for it in leisure through exercise. Such compensation is likely to be easier for regular exercisers than occasional exercisers, because the former notice more readily cues for compensating activities. A golfer, for example, may notice sunny weather late in the afternoon while at work, which is then a reminder of the rewards associated with hitting balls or playing.

Leisure's capacity for compensation becomes more evident upon examination of the characteristics of work and leisure. Work is typically a conscious, straining and freedom-undermining activity, whereas leisure is more a non-straining and freedom-restoring activity (48, 134). Although the freedom associated with leisure is generally seen as positive, it is also conducive to the dominating influence of nonconscious processing (47); unfortunately, nonconscious processing often leads people to seek out the least demanding activity ("law of least effort") for compensation. The result is that most people end up compensating through such readily cued and non-demanding activities as TV watching in their leisure.

Third, when faced with choosing to exercise in leisure, the problem of self-control depletion is further compounded by the triggered psychological reactance and the resultant activation of a sense of freedom or choice. This reactance and the tendency to choose non-exercise forms of leisure is in part a result of physical activity participation generally being promoted as a "do-it-or-else" health-promoting activity and not as fun experience. Thus, participation in any activity perceived as obligatory in one's free time is vigorously resisted unless a restriction on personal freedom is perceived as definite (55, 58), a non-choice option is highlighted (56), persistence is emphasized over a desirable choice (54), and high commitment to exercise goals has been made (57). In other words, certain restrictions on personal freedom are seen as everyday facts of life in which non-choice options are accepted and other characteristics (e.g., persistence) are instead embraced. Such perceptions can be helpful not only for mitigating the "negative" effects of freedom on choosing to exercise but reducing the role of conscious processing and enhancing that of the nonconscious. However, overcoming the importance of freedom in leisure through these and other ways in the second stage is difficult, because freedom is the defining characteristic of leisure (48, 134). Counterintuitively, the importance of freedom cannot be overcome by increasing choices within an obligatory activity, as it has been found that people choose sedentary activities over exercise even if they have multiple options for physical activity (135). Thus, threats to freedom, in combination with the tendency to follow the law of least effort, make it harder for conscious processing to promote continuity of exercise (Figure 1).

Nonconscious processing is inherently inclined to support the general human tendency to follow the law of least effort by making people more susceptible to noticing cues and excuses for not engaging in demanding activities, and cues for engaging in non-demanding activities (47). Recent experimental evidence showed that contextual nonconscious priming of anti-exercise goals decreased exercise, but nonconscious priming of exercise goals did not increase exercise (94).Thus, nonconscious processing operates to decrease the likelihood of choosing to exercise; it is easier to motivate people not to be active than to motivate them to become active (46, p. 103). Situational cues for saving time and for not being active abound in social environments (75, 136). Saving time, of course, is anti-exercise because exercise takes time, at the minimum 30 min. five times a week.

The above evidence highlights the nature and difficulty of the second stage. Both conscious and nonconscious processing work for and against exercise. On one hand, conscious processing lays the foundation (e.g., motivation and resolution of goal conflicts) for nonconscious processing to take over later in the third stage. This foundational work is necessary for the facilitation of regular engagement so that participation increasingly becomes reliant on situational cues and nonconscious processing. On the other hand, conscious processing resists continued exercise involvement through the activation of the need for personal freedom and the law of least effort. In a similar vein, nonconscious processing resists regular participation because it readily responds to cues for non-demanding activity and relaxation in one's free time. However, it also works for the advancement of regularity in participation through the strengthened cue-behavior relationship when exercise activity is repeated frequently. These conflicting tendencies within both conscious and nonconscious processing are a central reason why most people struggle in the second stage and fail to progress to the third stage of automaticity of engagement.

Conflicts between and among internal (e.g., motivation) and external (e.g., situational cues, temptations) factors, whether processed consciously or nonconsciously, reflect the cognitive nature and difficulty of engaging in regular exercise over and above the physical demands involved. This is beginners' and occasional exercisers' dilemma. If the conflict is between a non-demanding (e.g., TV watching) and demanding (exercise) activity, the latter has great difficulties in defeating the former. Research (137) has shown that simply forming a counterhabitual implementation intention to exercise without a strong goal intention will not break the old and competing habit (TV watching). Extrapolating from this study's data, even when a habitual response (watching TV) and an alternative response (exercise) have an equal chance of becoming an enacted behavior, the latter loses this "cognitive horse race" without a strong goal intention or commitment to exercise. Therefore, stronger measures of cognitive control have to be employed in such situations. Research suggests that visual monitoring (telling oneself "don't do it", i.e., watch TV) can aid habit control by enhancing conscious control processing (138). Simultaneously, inhibitory control training (e.g., brief mindfulness-training) could be employed as it has been shown to weaken implicit cognition (attentional bias) to competing or unhealthy stimuli (139), that is, TV watching in the above example.

Individuals who have not yet been able to make exercise habitual in the second stage can benefit from the mindfulness mindset. Evidence has shown the intention-exercise relationship is greater among mindful individuals and non-habitual exercisers than less mindful and habitual exercisers (140). Thus, the mindfulness mindset seems to facilitate the effectiveness of intentions by increasing self-control of and focus on action plans. In contrast, habitual exercisers do not need conscious intentions for their engagement as situational cues are sufficient to trigger the behavior. As habitualness grows (Figure 2), people become more reliant on "cognitive shorthand" or affective associations to drive their engagement (141). Chatzisarantis and Hagger's (140) data also demonstrate that mindfulness protects against the negative influence of counterintentional habits (e.g., habitual binge-drinking) on exercise behavior.

The above findings illustrate the essence of the second stage where individuals strive to move from conscious (mindfulness and intentions) to nonconscious processing triggered by situational cues. The mindfulness mindset and other cognitive strategies are needed to enhance conscious control until exercise is repeated frequently enough to be driven by situational cues. This progression is not linear as people slip in their participation (60), as reflected in the recursive relationships between the three stages (Fig. 2). The back-and-forth between conscious and nonconscious processing becomes more evident when conscious thoughts for one activity (exercise) and a nonconscious habit for another (e.g., TV watching) collide. Is it then any wonder why people encounter difficulties in attempts to progress from conscious to nonconscious processing in the second stage, and why the majority of the population remains permanently "occasional" exercisers? A challenge for empirical research is to determine how the two processes can complement one another to help people move to the third stage.

THIRD STAGE: NONCONSCIOUS PROCESSING AND HABITUAL BEHAVIOR

The third stage, *nonconscious processing*, is where behavior has become largely driven by nonconscious processing and situational cues. The resultant "fast thinking" or System 1 (18) is in charge. It is automatic, associative, intuitive, and impulsive, requiring little or no mental effort and deliberate thought. This level of nonconscious processing can be achieved fairly quickly in simple tasks (e.g., for reviews of research, see 19, 62), because responses can be repeated easily and frequently. However, it is a different matter with complex behaviors such as exercise.

It has been shown experimentally that exercise-related contextual (nonconscious) cues do not increase actual exercise participation (94), even if these cues make exercisers' reaction time to exercise stimuli faster than that of non-exercisers (142-143). This is not surprising given that there is a monumental difference between reaction time to a stimulus on a computer screen and going for a 30-minute run or walk. Nonconscious processing can become the dominant driver of goal pursuit only if behavior has been repeated frequently and regularly enough, and many more repeats are needed for complex than simple behaviors for the same level of automaticity. As pointed out earlier, most people are unable to achieve this automaticity (only 19% of beginning exercisers last five weeks without a lapse; 60). In contrast, however, those who exercise regularly (5 times a week or more) are continuously and gradually building the strength of situational cues for this behavior. It is these individuals (22% of the population) who have advanced to the third stage, because their exercise is effectively powered and maintained by situational and contextual cues without conscious deliberation and effort. This is not to suggest that the third stage is totally nonconscious in regard to exercise. Even regular exercisers have to exert cognitive control from time to time. But as explained later, such brief detours into conscious thoughts are in service of the dominant tendency of nonconscious processing to direct exercise behavior at this stage.

There is, of course, a multitude of situational cues for exercise in social environments such as the sight of joggers in neighborhoods. These cues are so ubiquitous that it is impossible not to encounter them. But if these cues and the associated nonconscious processing were powerful, everyone would be a regular exerciser. What, then, do these cues do to exercisers and non-exercisers? For the former, they can readily trigger this behavior (if they have not already exercised that day). For the latter group, the effects are binary: either no effect or arousal of cognitive dissonance (46-47). For non-exercisers, seeing a jogger in a neighborhood is just another environmental cue lost among many of them because it does not have any personal relevance and meaning. Even if joggers are seen every day and many times during a day, these cues do not build the strength of the cue-behavior relationship in observers, despite strengthening this particular cue in and of itself; the problem is that the cue (a jogger) is not associated with a relevant personal behavior. Cues alone do not have the power to trigger behaviors unless they are linked to specific behaviors through continuous repetition.

It is important to note that the cue-behavior relationship is also bidirectional. Besides cues triggering behaviors, behaviors also cause changes in cue strength. This phenomenon is particularly important in case of beginning exercisers. As would be expected, a previous episode of a behavior has an effect on a subsequent episode of the behavior, that is, prior exercise participation is a significant predictor of subsequent exercise engagement, but only up to a point. Armitage (60) showed that this effect occurred only during the first five weeks, after which the dropout rate leveled off, suggesting that participation had become habitual after five weeks. What these findings further, and perhaps more importantly, suggest is that the time (e.g., 5 vs. 12 weeks) when drop-out rates level off is not essential but rather, that this leveling off indicates the point where previous behavior no longer significantly builds cue strength. In a way, cue strength has reached maturity and the cue is ready to direct behavior, which has become habitual. Although the influence of previous exercise participation on cue strength is never-ending, it is clear that the repetition of a behavior is most important during the early phases of exercise engagement. Literally step-by-step, repeated behavior builds cue strength and finally, the point of no return to non-participation is achieved. At that juncture, cues and nonconscious processing have taken over the process. For some individuals, this construction work by previous behavior ceases by the end of the fifth week, for others much later. But it is unclear *where* that juncture is, *how* it is achieved, and *what* differences exist between various groups in this respect.

A situational cue can also have a temporary negative effect on non-exercisers, especially occasional exercisers. The sight of a jogger reminds them of the importance of exercise and simultaneously, of personal failure to exercise. The resultant dissonant thoughts have to be reconciled either behaviorally or cognitively. Since the cue-behavior relationship is weak among these individuals, they are likely to resolve dissonance by cognitive rationalizations and excuses (46). As people generally are good at rationalizing their behaviors, dissonance-causing cues can quickly be dismissed, rendering their negative effect short-lived among occasional and non-exercisers. This dismissal is further facilitated if the cue also activates threats to personal freedom. These threats can be eliminated by indulging in temptations (144) such as TV watching.

Sometimes, though, a cue and attendant dissonance can have a positive effect on occasional exercisers by making them resolve dissonance by behavioral means (i.e., going for a run/walk), especially if dissonance is accompanied by feelings of regret (145) and guilt (146-147). It follows that as the cue-behavior link grows stronger, actual exercise becomes a more likely way for resolving dissonance, depending on the severity of the dissonance. This topic remains a fruitful area for future research.

Nonconscious processing seeks simplicity

A central characteristic of nonconscious processing is to seek simplicity and concomitantly, to strive to reduce complexity in human cognitions and behaviors. The nonconscious lives in simplicity (2+2?) because it cannot handle complex cognitive operations (18, 61). As noted earlier, humans generally shun complexity and demanding cognitive and physical activities. As a result of these tendencies, complex behaviors (e.g., exercise) can become a part of activity repertoire only if they are reduced in complexity. This *reduction in complexity is achieved through increased habituation* (Figure 2). Consequently, exercise becomes increasingly simple both cognitively and physically. In general, the more frequently a behavior is repeated (and thus the stronger the cue-behavior relationship), the more readily it occurs in response to its situational and contextual cues, thus becoming more habitual (21). In short, reduced complexity leads to a greater likelihood of regularity in behavior, other things held constant. All of this means that exercise will not become a regular activity unless it is reduced in complexity to the level where it is driven by situational cues processed nonconsciously. Reduced complexity, of course, means simplicity or non-existence of conscious thoughts.

To be sure, even regular exercisers have to juggle mundane living demands (e.g., child care), thus being forced to take short detours into conscious thoughts, but such temporary barriers are likely to only briefly delay the start of physical activity. The underlying nonconscious processing for the behavior has already been triggered before a mundane demand surfaces. Theoretically, attempting to perform a behavior out of its normal sequence can prevent the action from being cued by the preceding action in the sequence (148) and therefore prevent it from being executed. Such an effect, however, is more likely to occur in simple tasks (e.g., reactions on computer keyboards) requiring quick sequential responses, whereas the effect is unlikely among regular exercisers due to the high level of habitualness of the behavior and because of the longer-lasting effect of the triggered cue. That is, a regular exerciser's engagement can be nonconsciously triggered by the sight of sneakers hours before actually going for a run, and this nonconscious effect does not disappear with brief detours into unexpected behaviors because the resultant plan to exercise can be held in the anterior medial prefrontal cortex during a delay period (90). Evidence suggests that people automatically adjust the selection and execution of their behaviors as long as the relevant goal has been primed (62). Nevertheless, it remains to be determined empirically how long the effect of the earlier-triggered nonconscious processing is maintained before it has to be reset by contextual cues.

Some forms of physical activity are simple to begin with, such as the "walking to the stairs" versus "elevator" point of choice. Although these simple behaviors are not exercise per se, they are useful everyday activities for burning calories in the long run. Placing signs ("Take stairs" or "Will you take the stairs?") near the point of choice can be effective depending on processing time constraints (149).The "take-stairs" signs become heuristic nonconscious "rules of thumb" under time constraints and lead to greater use of stairs. Extrapolating from the previously cited research, with repeated choice of stairs, this behavior grows into an automatic action and becomes cued by the context without the sign. Complexity can, of course, be reduced much faster with these kinds of simple physical activities than demanding forms of exercise. Nevertheless, the psychological process is the same in both and suggests that even complex exercise can be reduced into simple forms of action with frequent repeats.

Once formed, habits are stubborn. We perform habitual behaviors even when we do not want to engage in them. Graybiel and Smith (21) reported that rats would run to a reward (food) even when it had become distasteful. Similarly, people eat popcorn in movie theaters out of habit, regardless of its freshness (150). This level of stubbornness is possible only because ingrained habits are supported by the brain's multiple circuits that interconnect the neocortex and the striatum, with habitual behaviors becoming "chunks" (single units) of brain activity (21, 151). All the while, brain circuits monitor habitual behaviors without our conscious awareness. These findings suggest that frequent repeats of exercise develop the chunking neural pattern in the brain, which then supports continued participation. To reach this level of habitualness in exercise, however, requires a long period of time and a great number of repetitions of the behavior. It remains for future research to determine what the magic number of repetition is for different groups of participants and how it is achieved.

Achieving a high level of habitualness in exercise equates to building a psychological firewall against distractions. It is difficult to break a strong habit. Automatized behavior patterns are highly resistant to change. Laboratory research suggests that if a newly developed habit (e.g. going out for drinks after work) that competes with an older habit (e.g., exercise) is blocked, the old one instantly reappears (21). This is good news for regular exercisers living hectic lifestyles that can give rise to new and interfering habits. Even if they get side-tracked sometimes, the old habit of exercising quickly resurfaces and gets them back to doing the usual activity. However, before reaching this level of automaticity and habitualness in exercise, many pairs of shoes probably have to be worn out. But, one by one, each walking and running step builds automaticity and ultimately makes exercising as easy and mindless as brushing one's teeth in the morning.

It should be noted that even the most avid and regular exercisers occasionally have to rely on conscious processing and cognitive control because of situational demands. But sudden detours into conscious thoughts do not derail the influence of the dominant nonconscious processing because the goal of exercising had already been triggered or will quickly be re-triggered after unexpected behaviors. Furthermore, evidence suggests that when a goal has been primed, people nonconsciously adjust the behaviors available in their repertoire based on the perceived situation (62). This adjustment becomes easier with the reduced simplicity of exercise achieved through frequent repeats. The findings that complex everyday behaviors can reliably be primed (for a review of research, see 152) further support this adjustment process. Coupled with the evidence that habits are stubborn (21), it is clear that conscious thoughts and cognitive control play a relatively minor role in regular exercisers' actions in the third stage.

SUMMARY AND CONCLUSIONS

The scientific evidence accumulated in various areas of human behavior leaves little doubt about the need to be cognitively and physically active to maintain health. Research supports the use-it-or-lose-it principle, or its variant use-it-and-gain-it, and indicates that regular physical activity not only reduces the likelihood of major illnesses but also enhances neuroplasticity and neurogenesis (32-34), thus promoting a better performing and more efficiently running brain. In short, based upon research over the last 30 years, regular physical activity is the best thing people can do for their health (5). Does this biological and psychological imperative for an active lifestyle then translate into rational decision making and doing what is best for one's health? The fact that 68% of the population is overweight or obese and 78% fails to take advantage of the "free medicine" of exercise suggests that people do not make conscious decisions that are in their best interest. This is not surprising given the evidence that people are not rational about other matters either, such as their finances (18, 73, 75).

How do we explain most people's failure to exercise regularly? More fundamentally: Why do people choose to engage in some activities but not others? Why do some individuals spend 5 hours daily watching TV while others are active in their leisure? Given that enactment of behavior always emanates from the operations of the human mind, the answer can only be found in understanding conscious and nonconscious processing of human affect, cognition and behavior.

The role of conscious versus nonconscious processes in the initiation of action and movement has recently been debated at length, to the extent that it has divided researchers into two competing camps (81). Although empirical evidence seems to suggest that nonconscious processing starts a few hundred milliseconds before conscious processing, conscious intentions nevertheless are expressed before the onset of movement (84). However, there is no clear evidence about the starting point or location for neural processing for motor movements, with the processing likely beginning in several places simultaneously and involving distinct cortical circuits (20,90). Evidence further indicates that nonconscious and automatic processing can be suppressed and altered by conscious cognitions (61). The debate, therefore, about which comes first seems to miss the point, especially because there is plenty of evidence that, to a varying degree, both processes are jointly responsible for human behavior. The question, then, becomes one of determining how the two processes work together to influence complex daily behaviors.

In general, the initiation and maintenance of any complex and demanding behavior operates on a continuum of conscious-nonconscious processing such that when starting a new activity program (e.g., exercise), conscious processing dominates behavioral engagement. But after countless repeats, the nonconscious takes over and behavior becomes habitual, thereby being sustained in the long run. The present analysis goes beyond this general idea and proposes a 3-stage model according to which exercise behavior proceeds from the fully conscious processing in the beginning (1^{st} Stage) to predominantly nonconscious processing and automatic behavior (3^{rd} Stage). This theory and supporting empirical evidence suggest that most people fail to get past the second stage, conscious-nonconscious-conscious processing, therefore failing to become regular exercisers. In the third stage, even complex behaviors come to be driven by situational and contextual cues.

Building *exercise infrastructure* is an important part of the first stage. Participants discover *when, where, how, and with whom* to exercise. Evidence suggests that such an infrastructure has the potential to dramatically increase compliance with vigorous exercise programs (102). The infrastructure also means that participants set goals for engagement and ensuing outcomes. Exercise goals, however, cannot conflict with other activity goals and desires for leisure activities (e.g., media), because such a goal conflict brings about a self-control failure (98). Initial motivation for starting an exercise program appears to be a key for prevention of goal conflicts and maintenance of activity involvement. Research has shown that people with "want-to" (intrinsic) motivation experience fewer and weaker goal-interfering temptations, perceive fewer obstacles to goal pursuit, and exhibit stronger resistance to conflicting desires (118). In general, this self-determination motivation leads to self-regulatory success. As conscious self-regulation plays a central role in the first stage, the acquisition of self-regulatory skills becomes essential. For example, monitoring discrepancies between goals and current behaviors is important for self-control and goal achievement (100). Unfortunately, most people seem to fail in self-regulation as the proportion of people surviving the first five weeks of an exercise program without a lapse is less than 20% (60). All of this suggests that in the first stage, exercise has more to do with conscious self-regulation and conflict resolution than muscle movements.

Although no definite starting and ending points exist for the second stage, the third stage commences and the second stage ends when exercise has become largely or completely automatic and habitual. Research suggests that this can happen as early as in the fifth week (60), but if automaticity has not been achieved in six months, exercise is unlikely to ever become habitual. A key issue in the second stage is whether conscious processing increasingly gives way to nonconscious processing or whether the process continues to be dominated with such questions as, "Do I have time for it"? "Can I do it"? These kinds of questions become impediments to attempts to repeat the behavior, and therefore, to the dominance of nonconscious processing in driving behavioral engagement in response to situational and contextual cues. Nonconscious thoughts cannot become dominant if behavior is not repeated frequently enough to make situational cues sufficiently strong to elicit actual behavior (61).

The second stage is paradoxical in that both conscious and nonconscious processing work for and against participants' attempts to grow into regular exercisers. On one hand, conscious processing lays the foundation (e.g., exercise infrastructure) for the facilitation of later regular engagement driven by situational cues and nonconscious processing. On the other hand, it resists this progression to nonconscious processing largely due to the activation of "the law of least effort" (18) and of the need for personal freedom (50). Along with the general tendency to achieve a goal with the least amount of effort, the depletion of self-control resources (130) during a stressful working day leaves people with little mental strength for engagement in demanding activities in leisure (e.g., exercise), as well as to resist temptations for involvement in non-demanding activities, most notably TV watching (47). The problem is compounded by the activation of a need of a sense of freedom because exercise is promoted and perceived to be a "do-it-or-else" activity. When personal choice and freedom are made cognitively accessible, any activity perceived as obligatory in one's free time is vigorously resisted--unless a restriction on personal freedom is perceived as definite (58, 55) and as a necessary everyday fact of life in which a non-choice option is accepted and other characteristics (e.g., persistence) instead embraced (54).

Nonconscious processing also operates in the service of the law of least effort by making it more likely that cues will automatically trigger the adoption of excuses for non-engagement in exercise and trigger participation in less demanding activities. Experimental evidence (94) has shown that the contextual nonconscious priming of anti-exercise goals decreases exercise, whereas such priming of exercise-related goals does not increase exercise participation. This supports the idea that nonconscious processing is more likely to inhibit than facilitate exercise and that it is easier to motivate people not to be active than to become active (46). Nevertheless, nonconscious processing also works to advance continued participation by strengthening the cue-behavior relationship every time exercise behavior is repeated. As habitualness grows with repetition, people become more reliant on "cognitive shorthands" or affective associations with exercise (141) to drive the behavior. As a whole, however, the problem remains in that both conscious and nonconscious processing support and resist exercise. This conflicting tendency within and between the two processes is the key reason why people struggle in the second stage and are not able to move onward to the third stage.

In the third stage, nonconscious processing drives human behavior. But, to become an automatic and "fast thinker" about exercise is difficult, albeit possible, as indicated by the fact that 22% of the population are regular exercisers and their behavior is powered by situational and contextual cues (46). With their continuous and frequent repeats, these exercisers have built exercise into a powerful and stubborn habit that is not easily shaken (21). However, regular exercisers occasionally have to rely on conscious thoughts and cognitive control because of unexpected situational demands. But such brief detours into conscious thoughts do not derail the influence of the dominant nonconscious processing; if anything, they help nonconscious processing stay on track. Evidence suggests that goals for complex everyday behaviors (e.g., exercise), and thus these behaviors themselves, can reliably be primed (152) and that people automatically adjust their behaviors from their available repertoire based upon the perceived situation (62). This adjustment is easier when exercise is reduced in complexity via frequent repeats. But nonconscious processing can become the dominant driver of goal pursuit only if behavior has been repeated frequently and regularly enough; in general, many more repeats are needed for complex than simple behaviors for the same level of automaticity. Continuous exercise builds cue-behavior strength, ultimately leading to the point where the mere sight of a cue is sufficient to trigger exercise without any conscious deliberations.

Although the influence of previous participation on cue strength is never-ending, research (60) suggests that prior exercise has its greatest effect on subsequent exercise during the early phases of participation (i.e., the first five week); afterwards, the effect becomes nonsignificant and levels off. While the leveling-off point can vary individually, it signals that the cue-behavior relationship is now strong enough for nonconscious processing to be in charge of the behavior. Occasional exercisers, however, are not able to attain this cue-behavior strength in spite of continuously being exposed to a multitude of exercise cues in social environments (e.g., sight of joggers); for them, it is easy to dismiss or rationalize these cues away and thereby avoid the cognitive dissonance resulting from believing in the importance of exercise but not engaging in it. Occasionally, though, exercise cues can spur infrequent exercisers, through conscious deliberations, to go for a walk or run. A big challenge for future research is to determine how the cue-behavior strength can be built among occasional exercisers.

Nonconscious processing seeks simplicity because it cannot handle complex cognitive operations (61). It therefore strives to reduce the cognitive and physical complexity of exercise, and achieves it through increased habituation. When complex behaviors are reduced to the level of simple behaviors, they are much easier to repeat. This reduction in complexity is an important reason why habituation works in general and why people can habituate to complex behaviors (e.g., exercise). Research (21, 151) indicates that once a high level of habitualness has been attained, it is difficult to shake off habits. In short, habits are stubborn. This is good for regular exercisers but bad for avid TV watchers; if the latter want to become regular exercisers their task is exceedingly difficult. Research has shown that the stubbornness of habits is rooted in the multiple circuits in the brain's neocortex and is reflected by the fact that if a new and competing habit is blocked neurologically, the old habit instantly reappears (21).

But even the most avid exercisers are sometimes faced with everyday demands that disrupt their exercise routine. Although mundane living arrangements occasionally force regular exercisers into short detours of conscious thinking, these temporary barriers are unlikely to derail their habitual behavior. This is particularly true if a situational cue has triggered nonconscious processing in regard to exercise before an unexpected event occurred. It is unclear, though, how long the triggered nonconscious processing will last or can be suppressed by unexpected events before it has to be reset by another situational cue, or if out-of-sequence exercise has to be temporarily restarted by conscious thoughts. The way in which nonconscious and conscious processing puts the old habit of exercising back on the track after disruptions promises to be an interesting area for future research.

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