Autonomy: A Missing Ingredient of a Successful Program?

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ABSTRACT

SUPPORTING AN ATHLETE'S NEED FOR AUTONOMY BY ALLOWING HIM/HER TO MAKE CHOICES CONCERNING TRAINING VARIABLES CAN BE AN EFFECTIVE COACHING STRATEGY BY STRENGTH AND CONDITIONING (S&C) PROFESSIONALS. HOWEVER, THIS COACHING STRATEGY HAS RECEIVED LITTLE ATTENTION IN THE S&C FIELD DESPITE BEING EXTENSIVELY STUDIED IN THE FIELDS OF SPORT PSYCHOLOGY AND MOTOR LEARNING. AUTONOMY SUPPORT HAS BEEN SHOWN TO IMPROVE MOTOR LEARNING, PERFORMANCE, AND MOTIVATION. IN THIS REVIEW, THE POSITIVE EFFECTS OF PROVIDING CHOICES ARE DISCUSSED AS THEY APPLY TO ATHLETES AND S&C PROFESSIONALS. MOREOVER, POSSIBLE MECHANISMS FOR THESE EFFECTS ARE DESCRIBED AND PRACTICAL RECOMMENDATIONS ARE PROVIDED.

INTRODUCTION

The role of a strength and conditioning (S&C) professional includes teaching athletes how to proficiently perform exercises, thereby improving athletic performance, reducing the probability of sustaining injuries, and keeping them motivated over time. To achieve these goals, researchers and practitioners dedicate time and effort to investigating training-related variables, such as training frequency and duration, external load, number of sets and repetitions, exercise selection, and session rating of perceived exertion (RPE), among others. Such investigations are bearing fruit, as illustrated by the constant progression of training programs that improve athletic performance (30,40) and the reduced number of sustained injuries (22,34). However, until recently, the S&C profession was mostly led by research rooted in biomechanics and exercise physiology, and less so by sport psychology or motor learning. Fortunately, this is beginning to change. For example, a growing number of studies have demonstrated the effects that different attentional focus instructions have on S&C-related outcomes (29), such as jumping performance (48) and force production during the isometric mid-thigh pull (15). Previously, these instruction-interventions were only studied through motor learning lenses (49). Other findings from the field of motor learning and sport psychology offer practical and useful information, and S&C professionals would benefit from adopting such findings. In this narrative review, we introduce and discuss one such variable that, to date, has received little to no attention in the S&C profession, despite having thoroughly been investigated in the field of motor learning: the provision of choices as a way to support a performer's need for autonomy.

The Optimizing Motor Learning through Intrinsic Motivation and Attention for Learning (OPTIMAL) theory highlights 3 key practice conditions that are crucial for effective learning and performance (54). These variables include (a) enhanced expectancies for future performance, (b) an external focus of attention on the intended movement effect, and (c) conditions that support a performer's need for autonomy. Autonomy is the ability to make choices and exert control over one's environment. Fulfilling the need for autonomy promotes motivation and healthy psychological and behavioral functioning (8,9,47). The act of choosing is considered to be an inherent biological necessity (26) and a basic psychological need (8,9). By choosing,

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one is able to express preferences and reinforce the perception of control over their surroundings. Both humans and animals prefer to choose over not choosing, even if the chosen option affords no reward compared with the no-choice alternative (45,46). As evident by a growing number of neuroimaging studies, choosing activates specific regions in the brain associated with motivation and learning (see mechanisms section) (25,26). It is thus not surprising that studies have found that promoting participants' autonomy through choice provision increases intrinsic motivation and leads to positive effects across educational, workplace, and health contexts (35).

Numerous studies have investigated if choice provision can also improve motor learning and performance (50,54). A common research design involves dividing participants into a choice group (often called self-control group) and a (yoked) control group without choice. Although participants in both groups practice the task for a comparable amount of repetitions/sessions, those in the choice group are allowed to make a choice regarding one or more of the practice variables. For example, they may choose the number of repetitions to be completed, when to receive verbal feedback, when to stop the practice session, when to use assistive devices, or the order of the to-be-completed exercises. Participants in the control group are deprived of such choices, and are simply matched to participants in the choice group. For example, if a participant in the choice group decides to complete 3 sets of 10 repetitions in a given exercise, a participant from the yoked control group would then be asked to complete 3 sets of 10 repetitions of the same exercise. Results of such studies have consistently demonstrated that allowing participants to make choices enhances motor learning and performance. Despite consistent evidence for the benefit of providing autonomy support by including choices in program design, S&C professionals do not yet exploit autonomy for its beneficial effects. Therefore, the purposes of this narrative review are 3-fold: The first is to discuss how choices enhance learning and performance; the second is to describe the mechanisms underlying the observed, positive effects; and the third is to offer practical suggestions to S&C professionals as how to best implement choices as a training strategy with their athletes.

THE EFFECTS OF CHOICES ON LEARNING AND PERFORMANCE

For a deeper appreciation of this section, it is important to distinguish between motor learning and motor performance (28,42,43). Motor learning is a function of practice and reflects a relatively permanent change in a person's capability to perform a motor skill (28,42,43). As such, learning has to be inferred at some point after training (43). Commonly, learning can be measured in 2 ways: performance on retention or transfer tests. A retention test measures the learning effects of different practice conditions. Retention tests usually involve the task practiced during the acquisition phase. They are conducted after a certain retention interval usually after at least 24 hours, with all groups performing under the same conditions. A transfer test measures the transferability of what was learned under different practice conditions to a novel task variation or a novel situation. Similar to retention tests, transfer tests are conducted after a certain interval, with identical conditions for all groups. For example, a study could have participants practicing a basketball set shot from the free-throw line (15 ft) during the acquisition period. During the retention test, participants' set shot performance (i.e., form and accuracy) would be tested by shooting from the free-throw line (15 ft). For the transfer test, participants might be asked to shoot from a different location or distance (17 ft). Numerous studies have examined the effects of groups with choice versus no choice on motor learning, using retention and transfer tests. But, more recent studies have also looked at the immediate effects of choice on motor performance. Performance of tasks that require strength, speed, and power are, of course, also of relevance to the S&C professional.

MOTOR LEARNING

The results of motor learning studies investigating choices, described below, are mostly relevant to the effectiveness and efficiency in which athletes learn and maintain motor skills, such as the hang clean, squat, and running mechanics. This includes an athlete's ability to maintain proper form after a period over which the task was not practiced (e.g., off-session) or performed with a slight modification (e.g., performing the task using different equipment or on different surfaces).

Many motor learning studies on choices have examined outcome measures that require accuracy, balance, and form. Accuracy, commonly measured with tossing tasks, golf putting, and basketball shooting, is enhanced when participants receive choices during practice (1,12,21,27,36). For example, participants provided with a choice over the number of basketball set-shots they performed improved form and accuracy to a greater extent (~20%) relative to participants of a group who delivered a comparable amount of shots but absent of choices (37). Balance, usually measured with tasks performed on a force platform or stabilometer, is another quality that has been shown to improve in the presence of choices (16,27,50,55). For instance, balance improved (~30%) when participants chose the order of 3 balance exercises compared with the control group that completed the exercises in a set, predetermined order (50). Balance, accuracy, and form are skills relevant to athletic populations. By allowing athletes to make choices concerning the training program, improvements can be made beyond the manipulation of other, traditional training variables. Other choice options that have been manipulated and found to be effective in motor learning studies include the use of assistive devices (16,55), the amount of practice (36,37), and timing of delivered feedback (1,21).

The beneficial effects of the self-controlled practice are even seen when the choices are unrelated to the task (27,51,53). For example, allowing participants to choose the color of the ball they were about to throw or putt improved accuracy compared with the nonchoice group. Even a lasso throwing task was recently shown to have performance-enhancing benefits; when participants were allowed to choose the color of the mat placed underneath the target, throwing accuracy improved (~20%) compared with the matched yoked group (53). Although not all studies found comparable results (4), these findings highlight the motivational nature of the affect. From an S&C coaching perspective, this line of research suggests that the choice provision does not have to be significant, or even relevant, to enhance the learning processes of the athletes with whom they work.

Manipulating the coaching language has also been shown to affect motor learning. Hooyman et al. (18) observed that instructions that provided participants with a sense of choice in properly executing a bowling action (e.g., "…you may want to…," "…feel free to go at a pace you are comfortable with…") improved throwing accuracy scores (~20%), reporting of self-efficacy, and positive effect compared with participants who received instructions that offered little option for how to perform the task (e.g., "You must maintain a consistent pace," "Do not throw it at a side angle"). In a study by Halperin et al. (13), the verbal feedback boxing coaches provided to their athletes between rounds of competitions was recorded and analyzed. Interestingly, in bouts that were lost, the athletes received 8% more controlling feedback (absent of choice possibility) compared with athletes in winning bouts. Despite being an observational study, from which one cannot draw conclusions about cause-effect relationships, the results point to an interesting possibility that warrants future investigation. Accordingly, coaches should consider the influence that coaching language has on learning. Specifically, attempting to use language that allows athletes to feel a sense of control over their training environment is advantageous.

To summarize, the positive effects that choice provision has on motor learning are clear and consistent. The effects have been shown with a wide variety of choice options, ranging from task-relevant to irrelevant ones. Furthermore, the effects generalize across populations, including children, adults, and those with motor impairments (6,41,54). However, for the most part, the outcome measures in these studies are not directly related to the S&C profession. Hence, future motor-learning studies should also include outcome measures that are of greater relevance to the S&C field. For example, quantifying the effects of choices on weightlifting techniques, change-of-direction mechanics, and more.

PERFORMANCE

A few recent studies have investigated the effects of choices on performance. In a case study by Halperin et al. (14), a world champion kickboxer was instructed to deliver 2 rounds of 12 maximal-effort punches to a punching integrator, which measured forces and velocities, in either a predetermined order or in a preferred order. Note that, under both conditions, the same type and number of punches were delivered as single punches, rather than combinations. Across the 6 testing days, over which the order of the 2 conditions was counterbalanced, the athlete punched harder (5–10%) and/or faster (6–11%) under the choice compared with the no-choice condition. A follow-up study by Halperin et al. (14) repeated the same design with 12 amateur competitive kickboxers over 2 testing days and found similar, albeit smaller, effect sizes favoring the choice condition (forces: 3%, velocities: 6%). To the best of our knowledge, this was the first study to examine how choice provision affects performance rather than learning. It differed from common motor learning studies in 2 ways. First, in this study, trained athletes completed a task with which they were very familiar, in contrast to untrained participants completing a novel task. Second, the task required maximal levels of velocity and force production rather than the commonly measured accuracy or balance. These results are of great relevance to S&C professionals. They demonstrate that choice provision can lead to immediate and meaningful increases in velocity and force production among trained athletes including, for example, other power (force · velocity) training techniques such as plyometrics, Olympic-style resistance training (i.e., cleans, snatches), and sprint training might be expected to show similar benefits.

Confirming the immediate effects that choices have on performance, Iwatsuki et al. (19) reported that maximal handgrip strength was better maintained when participants were allowed to choose the order of hands in which trials were completed (dominant and nondominant). Although forces declined across the 3 repetitions in a yoked control group (from 398 to 371 N), participants in the choice group succeeded to maintain similar levels of forces to those observed during their first trial (397 N in first and last trial). These results strengthen the observations made by Halperin et al. (14) and further show that not only competitive athletes benefit from choice provision when it comes to maximal force production, but also untrained and recreationally trained participants as well. Additionally, the results point to the possibility that choice provision may postpone muscular fatigue–a sought-after adaptation in the S&C profession.

Periodized training programs commonly emphasize the manipulation of training variables, such as load and volume, but could also benefit from considering the effects of choice provision on program success. To the best of our knowledge, only 3 studies examined the effects of choices on the results of periodized programs (7,31,38). The choices included in these studies were (a) the repetitions to be completed within each session (31), (b) the order of the resistance-training sessions completed in a given week (7), and (c) the exercises to be completed in a given session (38). The comparison groups in these studies were deprived of such choices and completed the program in a predetermined order. McNamara and Stearne (31), who tested untrained females over a 12-week training period composed of 2 weekly sessions, observed that participants who were able to choose 1 of the 3 repetition ranges (either 10, 15, or 20) gained more strength in the leg press (~63 kg) compared with the control group (~16 kg). However, no other differences were observed between the groups in chest press 1 repetition maximum and long jump. These findings are of practical interest when considering that participants in both groups completed the same number of sets and repetitions across the training period.

Colquhoun et al. (7) investigated the effects of choice inclusion during a 9-week periodized resistance-training program composed of 2 strength and 1 hypertrophy sessions per week in resistance-trained males. Whereas participants in one group chose the order of the 3 different weekly sessions, participants in the control group completed the session in a predetermined order. At the end of the training period, no differences were observed between groups in strength, motivational levels, satisfaction with training, and session RPE. However, the authors reported that, in the choice group, only 2 participants were excluded/dropped out compared with 4 in the control group. Furthermore, 79% of participants from the choice group attended every training session, compared with 73% in the control group. Hence, choice provision may lead to greater adherence and attendance of training sessions, but further work is warranted to confirm this hypothesis. This perspective is supported by a study by Wulf et al. (52), in which participants first chose the order of 4 calisthenics exercises to be performed (choice group), or were told they would complete the exercises in a specified order. Subsequently, participants in both groups were asked to decide on the number of sets and repetitions they wanted to complete in each of the 4 exercises. Despite comparable baseline fitness, participants who were allowed to choose the order of exercises completed 60% more repetitions overall. Thus, a simple choice seems to increase an individual's motivation to exercise.

Selecting the exercises to be completed in each session over a training period is a novel way to examine the influence of choices on program success. Rauch et al. (38) had resistance-trained males complete a periodized program lasting 9 weeks (3 sessions per week). Participants were either allowed to choose the exercises they completed each day (1 exercise out of 3 possibilities per body part with 6 exercises overall) or completed them in a predetermined order. No statistical differences were found between groups in maximal strength, lean body mass, session RPE, or perceived recovery. However, the choice group accumulated considerably more total volume load (573,288 versus 464,600 kg). Given the large differences in training load and the similar session RPE and perception of recovery, it is possible that participants in the choice group were able to tolerate greater external loads without increases in measures of perceptual loads. Furthermore, a small advantage favoring the choice group was observed in the acquired lean body mass (0.6-kg differences). This small difference in lean body mass could partly be related to the effects choice provision have on eating habits. Being allowed to make various choices concerning the training modality, exercise intensity, exercise duration, and more led participants to consume overall considerably fewer calories and "unhealthy foods" after the training session, compared with their counterparts in the no-choice group (1,668 versus 2,356 kJ) (2). Hence, choices may even influence the quantity and type of foods participants consume.

As illustrated in this section, there are only a handful of studies that directly examined the effects of choice on performance, but those published suggest a positive influence on one or more of the measured outcomes. Given that choice provision can be easily implemented by coaches and that this strategy does not depend on expensive and/or specific technologies, it is a worthwhile endeavor to further examine this intervention through a more specific S&C lens. Also, including choices allows for greater coaching flexibility, which should reduce stress levels associated with coaching. Because the role of an S&C coach can be quite stressful due to the long hours required coupled with a myriad of responsibilities (10), including more choice options when designing programs can assist in reducing and managing the various stressors involved. Furthermore, emancipating athletes to make their own training decisions should develop a more motivated and independent individual, who may accept more responsibility for their own training and performance, thereby potentially fostering better adherence.

POSSIBLE MECHANISMS

The reasons underlying the consistent positive effects of choice provision are of great interest. Traditionally, the benefits of self-controlled practice (choice) have been explained with participants' being more actively involved in the learning process and deeper information processing of relevant information (3,5). More current accounts stress the motivational nature of the effect (54). The very act of making choices, independent of their relevance to the completed motor task, is rewarding and increases perceptions of autonomy and competence (26,54). Acting in an autonomous manner is considered to be biologically-motivated, as illustrated by the fact that even young infants prefer to choose from a number of options, even before going through any socialization processes (26,44). Indeed, it has been proposed that humans are born to choose (26). This perspective is supported by a growing number of studies showing that task-irrelevant choices improve learning to a similar extent as relevant ones (27,51,53). These results exemplify that the act of choosing, and not the content of the choice itself, is the decisive factor leading to enhanced learning and performance. Neuroimaging studies show that the act of choosing is associated with greater activation to the ventral striatum and ventromedial prefrontal cortex, areas of the brain associated with affect and motivation (23,25,33). The rewarding nature of choice seems to be a precondition, for example, for effective processing of error information (12,24). Differences in information processing seen between conditions that are or are not supportive of performers' need for autonomy are a consequence of the motivational impact of those conditions.

Autonomy is a key variable in the OPTIMAL theory of motor learning (52). It is seen as an important contributor to the linking of movement goals and necessary motor actions—termed goal-action coupling (52)—thereby leading to effective and efficient motor performance and learning. Having a sense of autonomy enhances expectations for positive outcomes and often results in higher self-efficacy and intrinsic motivation compared with controlling conditions (17). This allows performers to maintain their attentional focus on the task goal, without the need to engage in self-regulatory activity and the suppression of negative emotional reactions resulting from controlling environments (22). Reward expectations elicit dopaminergic responses that are important for the development of neural connections necessary for successful performance, including the production of force (11). Anticipation of reward has also been demonstrated to reduce beta-frequency electroencephalographic activity, which inhibits spinal motor activity (32). These influences contribute to the greater movement efficiency and effective coordination seen under autonomy-supportive conditions.

PRACTICAL RECOMMENDATIONS

Although more research is warranted, especially research pertaining to S&C-related outcomes, the current literature provides a good basis for providing general and tentative recommendations to S&C professionals regarding the role of autonomy and choice provision in program design. Mainly, the provision of choices should receive considerable attention by S&C professionals and researchers. It is a simple and effective training strategy that can easily be implemented independent of equipment. The remaining part of this section will deal with particular ways that choices can be used as an effective strategy.

First, we recommend following a less-to-more approach when it comes to the number of choices provided to new clients. That is, until coaches get to know the athletes with whom they work, and learn how, and to what, individuals and/or groups best respond to, it may be safer to start with fewer choice options. This recommendation is based on the possibility that too many choices at the initiation of a program may give the wrong impression that the coach is insecure, or alternatively, may lead to the program being followed in a disorganized manner, especially if working in group settings. Results of a study by Hodges et al. (17) support this coaching proposition. Providing novices with many choices concerning the training structure of throwing tasks (number and order of practice attempts and length of rest period) led to suboptimal motor learning compared with a group of expert musicians. Although the musicians had no experience with the throwing tasks, they were experienced in scheduling training sessions. These results suggest that although self-control practice facilitates learning, constraints are required until relevant training experience is gained. Accordingly, the number of choices could be restricted at the initiation of the program, while forming working relationships with athletes. The number of provided choices can, and probably should, grow with time. However, the number of choices should reach a ceiling, which remains to be identified, to avoid a choice overload: the condition in which an increase in the number of options to choose from may lead to negative consequences, such as a decline in motivation and/or the satisfaction with the chosen option (20,39). Whereas too many choices may lead one to feel overwhelmed, too few choices may not allow for the perception of control over one's environment to be realized (39).

Second, we suggest restricting the provided choices to a range rather than providing an open-ended choice. In other words, the provided choice should be a range that is within the constraints of the program goals. For example, rather than allowing athletes to choose the order of all exercises that are to be completed in a given session—a choice that is too open-ended and does not account for the goals of the program—we suggest allowing athletes to choose from a limited range of exercises that is in line with the goal of the session, such as choosing the order of 2 or 3 exercises. Moreover, the selected order of the exercises should not be expected to influence physiological adaptions over time. For instance, rather than letting athletes choose the order of 2 technical and heavy loaded multi-joint exercises such as the bench press and a squat—2 exercises that their execution order may influence the results—a more suitable choice selection may be between less technical and lightly loaded single-joint exercises, as their completion order is less likely to lead to meaningfully different physiological adaptations. The degree of choice restrictions depends on many factors, but a progression of a more-to-less restriction strategy over time (e.g., increasing the number of exercises that athletes can choose the order of their completion) seems like an acceptable resolution until more studies are conducted on this matter.

Third, the type of choices provided can range from task-relevant to task-irrelevant or incidental (27,51,53). In relevance to the S&C profession, examples of task-relevant choices include exercise order, number of sets and repetitions to be completed, feedback, and rest periods. Examples of task-irrelevant choices include selecting the color of the medicine ball, the squat cage or bench to be used for subsequent exercises, and the type of timer used. We see no reason for coaches to exclusively use one or the other as both are effective (27,51,53). Although research is needed to longitudinally examine if choice variation over a training period is more beneficial than a constant choice, it seems likely that varying the type of provided choices will, to some degree, elicit greater interest and lessen boredom. Thus, we suggest that coaches vary the type of choices throughout the training period while being mindful to the athletes they are interacting with and the unique training environment. Irrespective if the provided choices are task-relevant or incidental, instructional language that gives athletes some freedom in how they approach a task will be more effective than controlling language (18). Feedback and instructions that begin with "I suggest" and "Let's try" will likely lead to superior outcomes compared with "You must" and "I want you to." Additionally, asking for athletes' opinions may reduce defensive or anxious reactions, and provide the basis for less impeded task-focused activity. Accordingly, asking questions, such as "Which exercise would you like to start with?" may be beneficial.

Finally, the interaction between the coach, athletes, and the training environment should be considered when deciding on the various variables described above. Although it is clear that choices have a positive effect on motor learning, performance, motivation, and self-efficacy, it may very well be that some athletes respond more favorably than others to certain amounts, types, and degrees of choice, and that under some environmental circumstances, particular choices may be more suitable than others. For example, in a highly competitive environment of NCAA Division I training center, providing athletes with a choice concerning the repetition range to be completed in a given exercise (e.g., choosing between 10 and 15 repetitions) may be a suboptimal coaching strategy as the athletes may end up regularly choosing the upper repetition range to impress their coaches and teammates. Given this possibility, alternative choice options, such as exercise order, may be a more suitable coaching strategy in such a training environment. The rationale is that deciding on the exercise order is not a choice option that is expected to impress the coaches or teammates, in contrast to choosing the number of repetitions. However, when working with an accomplished and mature athlete in a one-on-one setting, providing the athlete with a repetition range choice may be more appropriate as she is less likely to feel competitive pressure or the need to impress her teammates or coach. Accordingly, the fine-tuning of the choice provision coaching strategy will likely be a product of an extended case-by-case interaction between coaches and athletes and the environment in which training takes place.

CONCLUSION

Supporting athletes' need for autonomy, for example, by allowing athletes to make choices regarding one or more of the training variables is an effective coaching strategy that should be used by S&C coaches. The opportunity for choice is associated with increased activity in the reward centers of the brain. Greater intrinsic motivation, enhanced performance, and more effective motor skill learning are all indicative of the rewarding function of choice. When substantial choices do not seem indicated, small choices may be sufficient to enhance performance and learning. Given the simplicity of this coaching strategy, careful and thoughtful usage of choice provision with athletes is a low-hanging fruit, and thus is a worthwhile endeavor.

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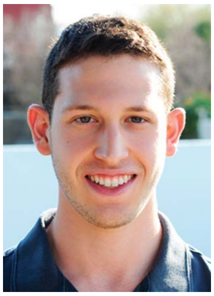

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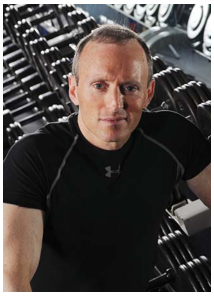

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