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The Effects of Choice on Intrinsic Motivation and Related Outcomes: A Meta-Analysis of Research Findings

Erika A. Patall, Harris Cooper, and Jorgianne Civey Robinson
Duke University

A meta-analysis of 41 studies examined the effect of choice on intrinsic motivation and related outcomes in a variety of settings with both child and adult samples. Results indicated that providing choice enhanced intrinsic motivation, effort, task performance, and perceived competence, among other outcomes. Moderator tests revealed the effect of choice on intrinsic motivation was stronger (a) for instructionally irrelevant choices compared to choices made between activities, versions of a task, rewards, and instructionally relevant options, (b) when 2 to 4 successive choices were given, (c) when rewards were not given after the choice manipulation, (d) when participants given choice were compared to the most controlling forms of control groups, (e) for children compared to adults, (f) for designs that yoked choice and control conditions compared to matched designs in which choice was reduced or designs in which nonyoked, nonmatched controls were used, and (g) when the experiment was conducted in a laboratory embedded in a natural setting. Implications for future research and applications to real-world settings are discussed.

Keywords: choice, motivation, intrinsic motivation, meta-analysis

Most Americans believe that having choices promotes health and happiness and that making choices is a way to meaningfully define themselves as individuals. The pervasive belief that choice is beneficial is evident in numerous aspects of American society. The concepts of "liberty" and "freedom" have played central roles in American ideology since the founding of the country. Consumer choice is the basis of our free market economic system, stimulating companies to continuously provide consumers with choices between new, improved, and competing versions of a product. The value of choice is used in campaigns meant to persuade the public to act or adopt specific political positions, such as "choose or lose" for encouraging young adults to vote in presidential elections, "school choice" for advocating educational voucher programs, and "pro-choice" for abortion rights. In each instance, the positive connotation of the word *choice* is used to promote a favorable attitude toward the advocated position.

Given this commonly held belief that choice can have a positive impact on an individual's feelings, beliefs, and behavior, it comes as no surprise that the concept of choice appears frequently in psychological theory and research. In this article, we examine the role of choice in motivation and behavior. First, we examine the overall effect of choice on intrinsic motivation and related outcomes. Next, we examine whether the effect of choice is enhanced or diminished by a number of theoretically relevant moderators, including the type of choice, the number of options, the total number of choices made, the administration of rewards, and how the comparison group is treated. Of methodological importance, we examine whether the effect of choice varies depending on how intrinsic motivation is measured. Finally, several additional methodological variables and characteristics of participants are examined in exploratory analyses. The background and hypotheses related to each of these issues are presented next.

The Effect of Choice

The presumption that feelings of having choice can be a powerful motivator is pervasive in motivation theory and research. Lewin (1952) showed that choice has a powerful motivating effect, demonstrating that people would be more likely to engage in an activity if they believed they had chosen it. DeCharms (1968) argued that the need for "personal causation" is a primary motivational force, suggesting that "when man perceives his behavior as stemming from his own choice he will cherish that behavior and its results" (p. 273). In fact, the need for choice may be so powerful that even choosing undesirable options may have beneficial effects. For example, Zimbardo, Weisenberg, Firestone, and Levy (1965) found that individuals perceived unpleasant activities, such as eating grasshoppers or administering electric shocks to themselves, as less unpleasant when they felt they had chosen to engage in those behaviors.

In line with the work of DeCharms (1968) and others, self-determination theory (Deci, 1980; Ryan & Deci, 2000) has provided the most comprehensive presentation of the link between choice and adaptive motivational outcomes. According to Deci

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Erika A. Patall, Harris Cooper, and Jorgianne Civey Robinson, Department of Psychology and Neuroscience, Duke University.

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Correspondence concerning this article should be addressed to Erika A. Patall, Department of Psychology and Neuroscience, Box 90086, Duke University, Durham, NC 27708-0739. E-mail: erika.patall@duke.edu

(1980, p. 26), "Self-determination is the process of utilizing one's will. This involves accepting one's boundaries and limitations, recognizing the forces operating on one, utilizing the capacity to choose, and enlisting the support of various forces to satisfy one's needs." According to self-determination theory, people are naturally inclined to interact with the environment in ways that promote learning and mastery (Ryan & Deci, 2000). The theory posits that autonomy, competence, and relatedness are three fundamental needs that underlie people's intrinsic motivation, or the propensity to engage in a behavior for its own sake (or out of enjoyment; Deci, 1971). Social contexts that satisfy these needs will enhance intrinsic motivation (Ryan & Deci, 2000). Therefore, intrinsic motivation is enhanced when an individual feels autonomous and in control of his or her outcomes and when information is provided about the individual's competence at navigating the social environment. When the environment is experienced as controlling, self-determination and intrinsic motivation are diminished (Deci, Connell, & Ryan, 1989).

Self-determination theory also posits that support for autonomy and intrinsic motivation will lead to other adaptive outcomes, including improved performance and learning and even better health. For example, in the context of the classroom, studies have positively linked the student's level of intrinsic motivation for schoolwork to positive academic performance (Grolnick, Ryan, & Deci, 1991; Pintrich & De Groot, 1990). Grolnick and Ryan (1987) found that elementary school students who reported greater intrinsic motivation for doing schoolwork displayed greater conceptual learning and memory compared to students with less intrinsically oriented forms of motivation. Significant correlations have also been found between intrinsic motivation and achievement as measured by standardized achievement tests in specific subjects, such as mathematics and reading for early-elementary, late-elementary, and junior high school students (Gottfried, 1985, 1990). Other research has shown a positive relationship between intrinsic motivation and well-being in various settings. For example, support for autonomy and relatedness has been found to predict greater well-being among nursing home residents and enhanced performance and well-being among employees in the workplace (Ryan & Deci, 2000).

Providing choice may be the most obvious way to support a person's experience of autonomy. As such, self-determination theory holds that choice should result in positive motivational and performance outcomes (Deci, 1980; Deci & Ryan, 1985; Ryan & Deci, 2000). That is, people will be more intrinsically motivated to persist at a task to the extent that the activity involves their personal choice and/or provides opportunities to make choices.

In fact, both laboratory and field research suggest that choice has positive consequences across diverse circumstances, including educational, workplace, and health contexts. The provision of choice has been found to lead to an increased sense of personal control (Rotter, 1966; Taylor, 1989), as well as to enhanced motivation, liking, and interest for a task (Cordova & Lepper, 1996; Iyengar & Lepper, 1999; Swann & Pittman, 1977; Zuckerman, Porac, Lathin, Smith, & Deci, 1978). In one seminal study on the effect of choice on intrinsic motivation, Zuckerman et al. (1978) found that participants who were asked to choose three puzzles to work on among six options spent more time engaged in the puzzle-solving task in a subsequent free-play period compared to participants who were assigned to work on three of the six puzzles.

Research examining the impact of choice has also supported the expected positive effect of providing choices on effort, task performance, subsequent learning, and perceived competence (Becker, 1997; Cordova & Lepper, 1996; Iyengar & Lepper, 1999; Kernan, Heimann, & Hanges, 1991). For example, Iyengar and Lepper (1999) found that Caucasian American students performed best when they made personal choices about which tasks to engage in rather than having the task chosen for them. Similarly, children provided with choices demonstrated greater learning, as measured by the number of problems answered correctly on a math test (Cordova & Lepper, 1996). Moreover, there is some evidence to suggest that the positive effects of choice remain even for choices that appear trivial (Cordova & Lepper, 1996; Swann & Pittman, 1977) or "illusory" (Langer, 1975). For example, choices described as instructionally irrelevant enhanced motivation and performance outcomes (Cordova & Lepper, 1996). Further, exercising choice can increase confidence and risk-taking even when outcomes are objectively determined by chance rather than the choices an individual makes (Langer, 1975).

Removing or Reducing Choice

According to self-determination theory, not only does choice enhance intrinsic motivation, but conditions that are experienced as controlling will also diminish intrinsic motivation (Deci et al., 1989). Similarly, in his work on learned helplessness, Seligman (1975) demonstrated that motivation and learning are impaired when people experience outcomes as independent of their actions and feel they have no control over a situation. Depression and anxiety were found to result when an individual experienced life choices as irrelevant. Brehm (1966) showed in his work on reactance theory that when people have choices, but then an alternative choice is explicitly eliminated, people experience a state of psychological reactance in which they will be highly motivated to regain and defend their personal freedom. According to reactance theory, this threat of restriction or elimination of individuals' ability to choose will cause them to evaluate more positively the alternatives they were not allowed to choose while evaluating the remaining alternatives more negatively.

Negative Effects of Choice

Despite this theorizing and evidence, other studies have found that choice may have no effect, or even a negative effect, on motivation and performance. A number of studies using the classic self-determination paradigm have suggested no effect of choice on motivation and performance-related outcomes (Overskeid & Svartdal, 1996; Parker & Lepper, 1992; Reeve, Nix, & Hamm, 2003). In a series of studies, Flowerday and colleagues (Flowerday & Schraw, 2003; Flowerday, Schraw, & Stevens, 2004) found choice had few positive effects. For example, giving students a choice between working on a crossword puzzle or an essay task showed no effect on engagement and task performance (Flowerday & Schraw, 2003). Students in the choice condition demonstrated reduced effort compared to students not given a choice of tasks. In a second study, students allowed to choose the pacing of the task spent less time studying and performed more poorly on cognitive

measures compared to students whose pace was dictated by the experimenter (Flowerday & Schraw, 2003). In two additional studies, no-choice participants were found to write higher quality essays compared to students who were given choice. Choice had no effect on a subsequent test to assess learning (Flowerday et al., 2004).

In line with these findings, some psychologists have suggested that choice may have disadvantages (Schwartz, 2000). In particular, according to the self-regulatory perspective proposed by Baumeister and colleagues (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Muraven & Baumeister, 2000; Muraven, Baumeister, & Tice, 1999), all acts of choice or self-control are effortful and draw on a limited resource that can be depleted, analogous to a source of energy or strength. Because all acts of volition or self-regulation draw on the same resource, any act of volition or self-regulation will have detrimental effects on subsequent acts that continue to require self-regulation. Consequently, engaging in a choice can result in a state of fatigue called *ego-depletion*, in which the individual experiences a decrement in the capacity to initiate activity, make choices, or further self-regulate.

Baumeister et al. (1998) have proposed that making choices is one form of self-regulation that can result in ego-depletion. Several studies have demonstrated the depleting effect of choice. Baumeister et al. found that participants who were given a choice of which side to take in a debate persisted for less time and made fewer attempts at solving subsequent puzzles compared to participants who were not asked to make a debating choice. In other studies, participants who made choices among household products demonstrated a reduced ability to exert self-control on a subsequent task (Vohs et al., 2004; see Bruyneel, Dewitte, Vohs, & Warlop, 2006, for a description). Specifically, participants who made choices drank less of a bad-tasting beverage, performed worse on a math test, and showed reduced persistence on a cold water pressure task. In yet another study, people who reported making more choices during a shopping trip performed more poorly on a subsequent math task (Vohs et al., 2004; see Bruyneel et al., 2006, for a description).

Of course, there is an important methodological difference between the ego-depletion and self-determination theory perspectives. Namely, researchers who have tested the effect of making choices within the context of the ego-depletion framework have always examined subsequent persistence on a task separate from the choice-making activity. Within the self-determination theory perspective, researchers typically have examined the effect of choice for the same task for which choices were originally made. Although it would seem to follow from the depletion model that intrinsic motivation (often measured as persistence on a task) would be diminished by choice regardless of whether the participant subsequently engaged in the same or a different task, this supposition has not been specifically posited by Baumeister and colleagues.

In response to contradictory predictions and findings offered by self-determination theory and the self-regulatory strength model, Moller, Deci, and Ryan (2006) offered one attempt at integration. Specifically, Moller et al. suggested that contradictory findings result from the lack of differentiation between choices that either promoted participants' sense of autonomy or provided them with a controlled form of choice. Moller et al. suggested that most often in studies of ego-depletion a controlled form of choice is implemented in which participants are led to pick a particular option. That is, although participants are told they have a choice among options, they are subtly pressured to pick a particular option. In contrast, studies coming out of the self-determination perspective generally provide an unrestricted choice with no indication provided as to which option should be chosen. In support of their hypothesis that differentiating between autonomous and controlled forms of choice would reconcile discrepancies, Moller et al. found that when an unrestricted autonomous form of choice was provided it had a beneficial effect in terms of persistence and performance outcomes, whereas ego-depletion resulted when a controlled choice was provided. In this set of studies, a paradigm typical of studies coming out of a self-regulatory strength model perspective was used in which the subsequent task was seemingly distinct and unrelated to the choices initially made. Consequently, when the task is related to the choices made, the conditions under which making choices will have a motivating as opposed to depleting effect remain unclear.

In this article, we use meta-analysis to examine the cumulative evidence on the effect of choice from within the self-determination literature. In line with self-determination theory, we predict that choice will have a positive overall effect on intrinsic motivation and related measures. However, in light of theoretical perspectives that suggest that there are limitations to the effect of choice and that making choices may even have detrimental consequences, we predict that there may be circumstances under which the positive effect of choice on motivation will be diminished. For example, we expect that the effect of choice will be mitigated, neutralized, or even potentially reversed under conditions of greater self-regulatory cost or under conditions experienced as controlling, as when rewards are provided. Likewise, in light of theoretical perspectives that suggest that the inhibition or removal of choice may diminish motivation, we expect that the effect of choice will appear more dramatic when it is compared to the most controlling no-choice conditions in which that absence of choice is made explicit. The following section discusses potential moderators of the effect of choice relevant to the theoretical perspectives just discussed.

Theoretically Relevant Factors That Affect the Utility of Choice

Mixed findings and conflicting theoretical perspectives suggest that the relationship between choice and motivation may be more complex than the commonsense belief that choice is unequivocally beneficial. It seems reasonable to expect that choice may be more or less effective for particular outcomes and under certain conditions. The type and number of choices to be made, the number of options in a choice, the presence of reward, and the way the comparison group is treated are all theoretically relevant contextual variations that may affect the magnitude or direction of the effect of choice. We address these briefly.

Type of Choice

Some researchers have suggested that not all types of choice will equally affect motivation. According to self-determination theory, some choices may be better than others at supporting needs for autonomy and will therefore have a greater impact on intrinsic

motivation and related outcomes. In particular, self-determination theorists have suggested that choices that allow one's actions to reflect personal values, goals, or interests will have the greatest effect on motivation, performance, and learning. Williams (1998) suggested that only meaningful choices that are similar in attractiveness will result in enhanced intrinsic motivation. If choices are unimportant, an individual may feel ambivalent about the choice rather than motivated by it.

Several studies have provided preliminary support for this idea. For example, Stefanou, Perencevich, DiCintio, and Turner (2004) suggested that there are three ways autonomy can be supported in the classroom, including organizational autonomy support (e.g., allowing students to choose the seating arrangement or participate in setting classroom rules), procedural autonomy support (e.g., offering students choices about the materials to use in classroom tasks or how competence will be demonstrated), or cognitive autonomy support (e.g., allowing students to generate their own solutions to a problem or evaluate various solutions). These forms of autonomy support may be seen as increasing in personal and instructional relevance, with organizational autonomy support providing the least opportunity for making meaningful choices and cognitive autonomy support providing the greatest opportunity for meaningful decision making. According to their model and observational data, different forms of autonomy support have different outcomes. That is, although organizational autonomy support may have positive effects on well-being and the level of comfort in the classroom, procedural and cognitive autonomy support may be necessary to enhance engagement and learning. In particular, cognitive autonomy support was theorized to have the most enduring motivational and learning benefits.

Similarly, Reeve et al. (2003) suggested that manipulations that offer choice between specified task options (i.e., "Do you want to read an essay on plants or animals?") may be less effective than more meaningful choices relating to the actions an individual takes to engage in and complete a task, including choices regarding method, pace, or goals. In reviewing the literature, Reeve et al. found that the pattern of results across the literature supported their claim. In particular, they noted that several studies that provided option choices, such as choosing between several versions of a task, did little to increase interest or performance (e.g., Overskeid & Svartdal, 1996; Schraw, Flowerday, & Reisetter, 1998), whereas studies that allowed participants to control the initiation and regulation of their behavior, in addition to providing option choices (e.g., Cordova & Lepper, 1996; Zuckerman et al., 1978), enhanced intrinsic motivation and subsequent learning. For example, Zuckerman et al. (1978) found that allowing participants to make choices about how to apportion their time, as well as choose among several versions of a task, enhanced intrinsic motivation.

In contrast, because the phenomenon of ego-depletion is dependent on exhausting self-regulatory resources (Muraven & Baumeister, 2000), this theory might suggest that although all choice has a depleting effect, choices that are less effortful (and therefore, less depleting) would have the smallest detrimental effects or might even be most likely to allow positive effects of choice. Conversely, choices that are the most consequential and personally meaningful, and therefore likely to be the hardest and most effortful to make, may actually be the most likely to result in ego-depletion and have detrimental effects on motivation, effort, performance, and learning.

Number of Options and Choices

Although motivation theory, as well as American society, has generally assumed that more choice is better, some research has suggested the effect of choice may not be so linear. Iyengar and Lepper (2000) showed that when presented with only 6 product options, passersby were more likely to purchase the product than when presented with 30 product options. Similarly, college students were more likely to write an essay for extra credit and write it better when provided with only 6 essay topics rather than 30 (Iyengar & Lepper, 2000). Presumably, and consistent with the ego-depletion perspective, choice becomes "overwhelming" and "demotivating" when there are a large number of options (Iyengar & Lepper, 2000; Schwartz, 2000). For similar reasons, the total number of choices an individual makes within a limited time frame may moderate the effect of choice on intrinsic motivation. That is, if an individual is asked to make an excessive number of independent choices within a limited time, choice may be experienced as overwhelming and may not enhance intrinsic motivation to the same extent. This perspective is consistent with an ego-depletion model in that effortful choice processes may drain one's internal resources to sustain volitional behavior (as it might when an excessive number of options or independent choices are presented), and negative effects may result. Conversely, in line with self-determination theory, all else being equal in terms of the nature of the choices provided, if an individual is presented with few options or choices, his or her perception of having experienced choice may not be as pronounced compared to when more options or choices are given. Given both theoretical perspectives, we might expect to find an optimum number of options and choices, in that too many choices may lead an individual to feel overwhelmed, and too few choices may not allow the perception of choice to be realized.

External Reward

Choice is not the only environmental factor that may affect intrinsic motivation. Recall that central to self-determination theory is the hypothesis that underlying intrinsic motivation are the psychological needs for autonomy, competence, and relatedness. Events that satisfy these needs will have a positive effect on intrinsic motivation, whereas events that impede the satisfaction of these needs will diminish intrinsic motivation. Consequently, extrinsic rewards have been found to diminish intrinsic motivation to the extent that they are interpreted by the individual as an attempt to control his or her behavior (Deci, Koestner, & Ryan, 1999). Thus, the uses of both choice and rewards may function to alter perceptions of autonomy, and therefore, each may have an effect on intrinsic motivation, albeit in opposite directions. It is not surprising then that research has addressed both contextual variables in a single design. This allows for the examination of the interactive effect of choice and reward on intrinsic motivation. Given the generally negative overall effect of reward on intrinsic motivation, we expect the presence of reward to diminish the beneficial effects of providing choice.

Control Condition

Clearly, when we interpret studies on the effect of choice, we cannot ignore how the control group is treated. Theories of reac-

tance, learned helplessness, and self-determination suggest that the type of control group used may have an impact on the magnitude of the effect of choice. Accordingly, in no-choice control conditions that are experienced as the most controlling, such as control conditions in which participants are explicitly denied a choice or in which they are aware of the alternatives that they are not allowed to choose, individuals may experience a particularly pronounced decrement in motivation. In essence, the outcomes of choice studies will be a function not only of variations in the choice condition but also of how no-choice participants are treated.

Characteristics of the Individual That Affect the Utility of Choice

Previous research has also suggested that the effects of choice may vary for different types of people. For example, culture is one factor that has been found to moderate the impact of personal choice on intrinsic motivation. In particular, in individualistic cultures (including the United States) personal agency, independence, and autonomy may be central to one's self-concept (Markus & Kitayama, 1991). However, in more collectivistic cultures (such as those in Asian countries) agency may have much less importance. Instead, non-Westerners may have more interdependent self-concepts (Markus & Kitayama, 1991). In line with this reasoning, Iyengar and Lepper's (1999) results demonstrated that intrinsic motivation was enhanced most for Caucasian Americans when they were making a personal choice. However, intrinsic motivation was enhanced most for Asian Americans when trusted authority figures or peers made choices for them. Recent attempts at replication have only partially supported these findings. In support, Bao (2005) found that Chinese students were more likely to engage in a word-search task when their mothers or teachers had made the choice for them compared to when they were allowed to make a personal choice. In contrast, Bao also found that for Chinese students who were not close with their mothers or teachers, making a personal choice enhanced self-reported intrinsic motivation for the target task more than when mothers or teachers chose for the students. However, there was no benefit of having made a personal choice for students who were close with their mothers. Clearly then, culture is an important variable to consider in assessing the benefits of personal choice.

Other individual differences might also impact the effect of choice. Previous meta-analyses examining other aspects of self-determination theory have found variation between children and adults. Specifically, Deci et al. (1999) found that tangible rewards are more detrimental to intrinsic motivation for children than for college students, potentially as a result of differences in cognitive capacity and/or the less frequent experience of rewards by children compared to adults. On the basis of this precedent, we might also expect to find that choice has greater impact on children compared to adults.

Methodological Factors That Affect the Utility of Choice

Certain methodological factors may also be expected to affect the outcome of choice manipulations in any particular study. Studies have generally employed two types of measures to assess intrinsic motivation: behavioral and self-report (Deci et al., 1999). However, differences in results of the two measures or failure to obtain significant correlations between the two measures when both were used in the same study have led some researchers to doubt whether the two types of measures can be considered alternate indexes of the same underlying construct (Wicker, Brown, & Paredes, 1990). In fact, a previous meta-analysis of the effect of extrinsic rewards on intrinsic motivation conducted by Deci et al. (1999) found that although there was a significant negative overall effect of rewards on behavioral measures of intrinsic motivation, the effect of rewards was null for self-report measures. Each type of measure has its own set of strengths and weaknesses. Namely, behavioral measures have the advantage of greater mundane realism, whereas self-report measures may be subject to systematic reporting biases, including social desirability, acquiescence, and retrospective reconstruction of prior events. On the one hand, behaviors are gross measures that have multiple determinants. As such, they are less sensitive to manipulation, especially the type of manipulation that can be accomplished in most experimental settings. On the other hand, self-reports might often reflect beliefs about dispositional aspects of the self that are relatively consistent over time. Consequently, we might expect to find differences in the effect of choice on behavioral compared to self-report measures.

In addition to differentiating between self-report and behavioral measures of intrinsic motivation, we can also provide more refined categories of intrinsic motivation measures. Namely, intrinsic motivation has sometimes been measured behaviorally as the time participants spend on the target activity during a free-choice period subsequent to the experimental phase or as the proportion of participants who spend any time with the target activity during the free-choice period. Alternatively, intrinsic motivation has been operationalized as the degree to which participants report enjoying the activity, finding the activity interesting, or being willing to engage in the activity again. We have no specific predictions as to whether or how choice may differentially predict particular measures of intrinsic motivation. However, it seems reasonable to explore whether the impact of choice varies depending on the intrinsic motivation outcome measure used and, if differences are found, to suggest some post hoc explanations for testing in future research.

The context in which choice is administered may also affect the outcome of choice studies. That is, choice may be particularly beneficial in settings in which it makes intuitive sense to have choices, seems most realistic, or is most meaningful. For example, choice may be expected to have a larger effect when it is administered in a classroom with students or in a workplace with workers as opposed to in a contrived laboratory setting. Alternatively, choice may have a greater effect when other variables confounding its effect on intrinsic motivation can be most effectively controlled, as in a traditional laboratory setting. Consequently, we might expect to find differences in the effect of choice on intrinsic motivation depending on whether the experiment was conducted in a laboratory compared to a natural setting.

Finally, there was one methodological variable for which theoretical perspectives were also relevant. First, of methodological relevance, whether or not a study uses a yoked or a matched design may affect the outcome of choice studies. In a yoked design, the experimenter matches a control participant with an experimental participant so that in both conditions there are an equal number of participants doing the same task or having the same task options

(e.g., Iyengar & Lepper, 1999). In this way, a yoked design will perfectly control for the confounding effect of the task or option the participant chose or was assigned. Matched designs also attempt to control for the confounding effect of task; however, this is accomplished by excluding participants who do not engage in a target activity or option. It is important to consider whether variation attributable to the task is controlled for and whether yoked or matched designs produce results different from designs in which yoking was not used.

As a second aspect of study design, the nature of a matched design often necessitates that the experimenter take measures to ensure that choice participants choose a particular option so that a large amount of participant data will not have to be thrown away. Said another way, there can be an excessive waste of participant data, resources, and time in matched designs if many choice participants do not choose the target task or option. To reduce the possibility that lots of data will have to be excluded, studies that use matching often employ subtle pressuring to get participants in the choice condition to choose the "right" option. For example, New (1978) gave participants a choice of six game-type activities, whereas all control participants were assigned one activity, to listen to a comedy tape. However, the experimenter also stated to choice-condition participants that fewer people in previous sessions had chosen to listen to the comedy tape, and therefore, it would be really helpful if the participant engaged in that activity, though the choice was totally his or hers. Alternatively, researchers sometimes attempt to reduce the discarding of data by providing options that are not equivalent. In this tactic, one option is more attractive (the target option) than others, which ensures that most participants in the choice condition will choose the target option. For example, Jagacinski (1978) gave participants in the choice condition a choice between doing tangram puzzles or division problems, with the expectation that most participants would find tangram puzzles more interesting and would choose that option. In sum, matched designs often necessitate that participants feel as if they do not really have a true or totally free choice. That is, although they are given the opportunity to make a choice, they are also given (a) reasons to select a particular option or (b) one option that is more desirable than others. According to self-determination theory, choice will be most effective when it is meaningful and indeterminate (Williams, 1998). Further, conditions experienced as controlling are proposed to diminish intrinsic motivation (Deci et al., 1989). Rather than enhancing feelings of autonomy, such reduced or pressured choices will more likely result in participants feeling controlled. Consequently, we expect that this design would be associated with a smaller effect of choice on intrinsic motivation compared to other designs.

Need for a Synthesis on the Effect of Choice

Clearly, a large literature on the effect of choice has accumulated over the last 30 years, making a synthesis of the empirical findings particularly timely. Given conflicting findings within the self-determination theory literature, a meta-analysis might answer the most basic question of whether choice does indeed have a beneficial effect on intrinsic motivation and what moderators might explain the conflicting findings. Although the theoretical underpinnings of self-determination theory provide guidance as to what moderators may diminish or magnify the effects of choice, few have been put to empirical test in the primary literature. The type of choice,[1] number of choices made in a single manipulation, age of the participant, experimental setting, and use of a yoked or matched design are all moderators tested in this meta-analysis that have never been investigated in a single study. Further, though the effects of choice and reward have often been studied in isolation, few published studies have systematically examined the interactive effect of choice and reward. Meta-analysis provides a means to assess the impact of variations in the effect of choice that have been examined within studies, as well as variations that occur between studies. Further, the potential power of a self-regulatory perspective to explain when choice is of limited value for enhancing motivation also justifies a systematic evaluation of potential moderators of the choice–motivation relation. Finally, this meta-analysis builds on Deci et al.'s (1999) meta-analysis of the impact of external rewards on intrinsic motivation in that it continues the systematic synthesis of accumulated results addressing the tenets of self-determination theory on a component-by-component basis.

On the basis of relevant theoretical approaches to the effects of choice, we made the following predictions:

> Choice will have a positive overall effect on intrinsic motivation and related outcomes.
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> The effect of choice will be optimized by a moderate number of options and choices because too few choices may not allow the perceived effect of choice on feelings of autonomy to be realized, whereas too many choices may lead to ego-depletion.
>
> The presence of reward will diminish the beneficial effects of providing choice.
>
> There will be a greater positive effect of choice when compared to the most controlling forms of no-choice conditions. In particular, the effect of choice will be greatest in comparison to control conditions in which participants are either aware of not having been given a choice or are explicitly denied a choice they have made. The effect of choice will be smaller in comparison to control participants who are simply assigned an option without any knowledge of alternatives or how they were given task or option assignments.
>
> There will be a smaller effect of choice for matched-design studies in which tactics are used to ensure a particular option is selected compared to designs in which such tactics are not used.

In addition to these theoretically based predictions, we also tested whether the effect of choice varied depending on the type of choice made. Although self-determination theory would predict

[1] Reeve et al. (2003) did assess the impact of different types of choice. However, the effect of a choice made between versions of an activity was compared to a combined choice condition in which participants both chose between several versions of an activity and made instructionally relevant choices about their pace while engaging in the activity. In contrast, this meta-analysis is the first to examine the unique impact of discrete types of choice.

that the most meaningful forms of choice that tap an individual's values, interests, or goals would have the strongest effect, a self-regulatory strength perspective would predict the opposite. According to this perspective, more meaningful choices should predict even stronger negative effects of choice. Consequently, we did not make predictions about the effect of this theoretically relevant moderator.

Several other moderators were tested because the literature suggested they could have important influences on study results, even though a theoretical rationale for their influence was lacking. These variables included the age of the participants, the type of intrinsic motivation measure (behavioral vs. self-report), the component of intrinsic motivation measured (time spent on task, enjoyment, interest, and willingness to engage in task again), and the experimental setting (natural vs. laboratory setting).[2]

Method

Literature Search Procedures

A variety of complementary search strategies were used to uncover both published and unpublished research and to minimize any systematic data censoring. The first strategy involved computer searches of the ERIC, PsycINFO, Sociological Abstracts, ABI/INFORM, and Dissertation Abstracts electronic databases for documents catalogued before September 2006. Varying combinations of the following search terms were entered for all searches: choice, choice behavior, motivation, intrinsic motivation, self-determination, and achievement motivation. In addition, Science Citation Index Expanded (SCI EXPANDED) and the Social Sciences Citation Index (SSCI) databases were searched for documents catalogued before September 2006 that had cited Zuckerman et al. (1978). Next, six researchers whom our database searches revealed had published two or more articles on choice and motivation were contacted directly in order to tap choice-related research that would not be included in the reference and citation databases. Finally, the reference sections of relevant documents, including articles included in the meta-analysis as well as relevant review articles, were examined to determine if any cited works had titles that also might be relevant to the topic.

Criteria for Including Studies

For a study to be included in the research synthesis, several criteria had to be met. Most obviously, all studies included in the meta-analysis employed manipulations of choice. This meant that participants in experimental conditions had to be provided some type of choice relating to the task they were involved in for the study. Participants in a control condition received no such choice. In a typical paradigm, first participants are given some type of choice relating to the experimental task. For example, participants may be asked to choose which task or version of a task they would like to engage in, or the participants may choose some aspect of the task. Next, participants engage in the task about which they made a choice. Finally, motivation and related outcomes are measured. Given this criterion, studies contributing to this meta-analysis generally came out of the self-determination perspective. Those studies coming out of a self-regulatory strength depletion literature were excluded because in these studies persistence and performance were always assessed for a task that was seemingly unrelated to the choices the participant initially made. For example, a typical paradigm coming out of this perspective would be one in which participants are asked to make a choice about which side of a debate to take, and then persistence and performance outcomes are measured on an unrelated puzzle-solving task.

Further, because the effect of choice on intrinsic motivation was our primary interest, a study had to measure intrinsic motivation to be included in the synthesis. If a study reported the effect of choice on other related outcomes (such as effort, task performance, subsequent learning, or perceived competence), we also recorded these effects. This criterion was employed in order to reduce the heterogeneity of the sample of studies and to render the effect of choice on intrinsic motivation more comparable to other related outcomes.

The studies included in the meta-analysis were all experiments with at least one experimental and one control group. Only studies in which participants were asked to make a choice between specified or unspecified options were included. A small number of studies that used a manipulation in which a choice was implied in the experimental condition but no actual choice was made were excluded.

Two sampling restrictions were placed on included studies. The studies used in the synthesis were restricted to those conducted in the United States and Canada with normal populations. Consequently, two studies using learning disabled and behaviorally disordered children as the target sample and eight studies containing non-North American samples were excluded from the meta-analysis. Because very few studies were found that employed restricted samples and samples from other countries (and few other countries were represented among the studies), we felt that including these studies still would not warrant generalizing conclusions about the effect of choice to restricted populations or populations outside North America. Although moderator analyses could have been helpful in order to determine whether the effect of choice varied across cultures, with so few studies contributing to the composite effect for various countries these analyses would not have been reliable.

Studies that utilized a one-group posttest-only or a one-group pretest–posttest design were not included. Studies employing a nonrandom process of assigning participants to conditions and/or post hoc statistical procedures to equate choice and no-choice groups were also not included in the meta-analysis. Similarly,

[2] Although we expect that culture would moderate the effect of choice, this meta-analysis did not permit this prediction to be assessed due to a lack of reporting or a lack of variation among the studies along the characteristic of culture or ethnicity. Further, we did test whether the magnitude of the effect of choice on intrinsic motivation varied depending on the gender of the participant. However, few studies had samples that were exclusively of a single gender or that were separated so that an effect could be computed for each gender separately. Consequently, only 11 effects contributed to this moderator analysis by gender. Nevertheless, results suggested that gender might moderate the effect of choice. Under both fixed- and random-error assumptions, the weighted mean *d*-index was significantly higher for females ($k = 8$; FE: $d = 0.26$, 95% CI = 0.14, 0.38; RE: $d = 0.46$, 95% CI = 0.18, 0.74) than for males ($k = 3$; FE: $d = -0.02$, 95% CI = −0.27, 0.22; RE: $d = -0.02$, 95% CI = −0.27, 0.22), FE and RE: $Q(1) = 4.18$, $p < .05$.

single-group cross-sectional studies using multivariate statistics or simple bivariate correlations to describe the choice and motivation relationship were not included. Finally, the report had to contain enough information to permit the calculation of an estimate of the effect of choice on a relevant outcome.[3]

Dependent Measures

This synthesis assessed the effect of providing choice on multiple related outcomes. Although we were primarily interested in the effect of choice on intrinsic motivation, we also assessed the effect of providing choice on a number of other related measures, including effort, task performance, subsequent learning, perceived competence, satisfaction with the task, preference for challenge, pressure or tension, and creativity.

Intrinsic motivation was assessed in the included studies with a number of different measures. One frequently used measure was the degree to which participants return to and persist at the target activity during a free-choice period subsequent to the experimental phase. In this paradigm, the experimenter usually informed the participant that the experiment had come to its conclusion and then offered a pretext for having to leave the participant alone with the task for a specified period of time. During this time, the participant was given no extrinsic reason to reengage in the task, was unaware of being observed, had access to interesting alternative activities, and was free to do as he or she pleased. The more time the participant spent on the target activity, the more he or she was assumed to be intrinsically motivated to perform the activity. In 81% of studies using this free-choice persistence measure, intrinsic motivation was assessed as the time spent on the target activity during the free-choice period. In the remaining studies, data were presented as the proportion of participants who spent any time with the target activity. Both behavioral measures of intrinsic motivation were included in the meta-analysis. Only measures in which the persistence on the target activity was assessed following the experimental phase were included. Measures that assessed persistence during the experimental phase were excluded.

Intrinsic motivation was also assessed with self-report measures of intrinsic motivation for the target activity. Self-reports of intrinsic motivation were assessed as either a single item or multiple items. Some of the multiple-item scales had undergone previous validation. In many cases, multiple-item scales included questions pertaining to both interest and enjoyment or liking. In other cases, self-reports of interest and enjoyment or liking were assessed separately as either single-item indicators or multiple-item scales. Finally, intrinsic motivation was sometimes assessed as self-reported willingness to engage in the task again. In every case, willingness to engage in the task again was assessed as a single item. The form of this item varied across studies. Examples of measures of willingness to engage in the task again included assessments of whether or not the participant volunteered to stay at the experiment site and continue working on the task, willingness to return to spend additional time working on the task, the number of minutes participants volunteered to return to the task, whether or not the participant requested a copy of the task, and self-reported willingness to engage in similar tasks in the future. We also included assessments of intrinsic motivation that were composites of both behavioral and self-report measures.

The measures of task performance varied across studies depending on the task being used. Generally, task performance reflected the accuracy of the participants' performance on the experimental task and was measured by the percent of the task performed correctly or the number of correct trials during the experimental phase. In some cases, task performance reflected the quantity of the task completed. For example, in a study using a word maze, task performance was measured by the total words found during the experimental task. Although task performance reflected the participants' immediate performance, subsequent learning was generally measured with a follow-up test assessing skills the participants may have acquired while engaging in the target task during the experimental period. In some cases, a comparable pretest was administered to participants, and the difference between the pretest and posttest was taken as the measure of learning. Measures of task performance administered following the experimental phase were excluded so as to maintain the conceptual distinction between task performance and subsequent learning.

Effort was frequently assessed as a self-report measure that asked participants the extent to which they had exerted effort on the target activity. Self-reports of effort were assessed as either a single item or as multiple items that were sometimes validated scales. Effort was measured behaviorally as the number of trials attempted during the experimental phase in two cases (Iyengar & Lepper, 1999; West, 1993) and as a combined measure of the time spent and number of mouse clicks on a computer during an experimental phase in another case (D'Ailly, 2004).

Several other related measures included perceived competence, preference for challenge, felt pressure or tension, creativity, and satisfaction. These measures were assessed with less frequency than measures of intrinsic motivation, task performance, effort, and subsequent learning. Perceived competence for the activity was defined as the extent to which individuals felt they could master the task and was assessed with a self-report measure with either a single item or multiple items that were sometimes validated scales. Creativity was defined by the originality and appropriateness of thoughts. In all cases, an assessment of creativity was made by ratings of multiple independent judges. Preference for challenge was assessed in two studies and was measured behaviorally as the percentage of cases in which participants chose a more challenging problem trial compared to easier problem trials while engaging in the task during the experimental phase. In all cases, pressure or tension was assessed via a validated self-report measure in which participants were asked to report the extent to which they felt tense or anxious compared to relaxed. Finally, satisfaction was assessed with multiple-item self-report scales that asked participants to report how satisfied they were with the task and their performance.

Information Retrieved From Studies

Numerous different characteristics of each study were included in the database. These characteristics encompassed five broad distinctions among studies: (a) the research report, (b) the choice manipulation, (c) the sample, (d) the outcome measure, and (e) the

[3] Tables describing the characteristics of excluded studies will be provided upon request.

estimate of the effect of choice on the motivation-relevant outcome. Table 1 lists the characteristics of the studies that we coded.

Several aspects of coding, in particular the type of choice, reward condition, and control group, involved some subjective judgments. Below, we discuss the criteria for grouping studies into categories for each of these codes.

Table 1
Complete List of Information Retrieved From Studies

Report characteristics
1. Author name
2. Year
3. Type of research report (journal article, book chapter, book, dissertation, master's thesis, private report, government report, school or district report, conference paper, other type of report)

Choice manipulation
1. Type of activity (verbal, quantitative, spatial, physical, art, computer/video game)
2. Interesting task or not (based on statement made by author/pilot testing of activity; yes/no)
3. Length of the initial work period
4. Type of choice (choice between activities, choice between versions of an activity, choice between instructionally irrelevant aspects of an activity, choice between instructionally relevant aspects, choice between rewards for the task)
5. Equally interesting choice options (yes/no)
6. No. of options chosen between per choice
7. No. of options chosen
8. Multiple choices provided (yes/no)
9. Type of choice for additional choices
10. Equally interesting choice options for additional choices (yes/no)
11. Total no. of choices made
12. Yoked or matched design employed (yes/no)
13. Evidence of a contaminant (yes/no)
14. Nature of the control group (significant other chose, nonsignificant other chose, randomly assigned, denied choice, suggested choice, other)
15. Control group knowledge of the alternatives (yes/no)
16. Matched between task for which motivation was measured and task for which choice was manipulated (yes/no)

Sample
1. Sample label (kindergarten-12th grade students, general college students, psychology major college students, general adults)
2. Ability label (gifted, average, at-risk, underachieving, learning deficit, behaviorally disordered, general)
3. Socioeconomic status (low, low-middle, middle, upper-middle, upper, mixed, no socioeconomic status information)
4. Age
5. Grade level (if applicable)
6. Gender
7. Ethnicity (Caucasian, African American, Asian American, Hispanic, Native American, other, not specified)
8. Setting (lab, school, workplace, other, not specified)

Outcome measure
1. Outcome (free-choice measure of intrinsic motivation; self-report measures of overall intrinsic motivation, interest, enjoyment or liking, willingness to engage in task again, task performance, effort exerted, subsequent learning, engagement, satisfaction, preference for challenge, perceived competence, general motivation, other)
2. Type of outcome measure (validated scale, experimenter-created scale, single item, behavioral measure)
3. Sample size for choice and no-choice groups
4. When the outcome was measured relative to the end of the manipulation

Estimate of the effect
1. Direction of the effect
2. Magnitude of the effect

Studies were grouped into five categories on the basis of how choice was manipulated. Choice manipulations in which participants chose between multiple discrete activities were categorized as *choices between activities*. For example, in one study by Flowerday and Schraw (2003), participants were asked to choose between completing an essay task or a crossword puzzle. Alternatively, studies that asked participants to make a choice between multiple *versions of a single activity* were placed in their own category. For example, Iyengar and Lepper (1999) asked participants to choose between six categories of anagrams: anagrams on animals, parties, San Francisco, family, houses, or food. Studies also used manipulations in which participants were asked to choose either *instructionally relevant* or *irrelevant aspects of a task*. Studies were categorized as employing instructionally relevant choices if the aspects of choice could change the effectiveness of the task for learning purposes. For example, D'Ailly (2004) asked participants to choose which color names they would like to learn in a foreign language, and Becker (1997) asked auditors to choose the financial ratio they would use in order to calculate bankruptcy predictions. In contrast, Cordova and Lepper (1996) asked participants to make choices about the fantasy aspects of a computer game that taught mathematics skills, such as the icon used to display the player or the name given to the player and opponents in the game. Similarly, Dwyer (1995) asked choice participants to choose what music would be played during an aerobics class. These studies are examples of those categorized as using an instructionally irrelevant choice. Finally, some studies gave participants a choice about *the reward they would receive for the task*. For example, Marinak (2004) allowed participants to choose the book they wanted as a reward for engaging in the activity.

According to self-determination theory, the administration of extrinsic rewards can decrease intrinsic motivation for interesting activities. Given the relevance of reward to intrinsic motivation, a number of studies examined the impact of both reward and choice on intrinsic motivation within a single design. Specifically, some studies used a factorial design such that the presence of reward was manipulated in addition to choice. These studies thus provided the effect of choice when *no reward* was given, as well as the effect of choice when a *reward external to the choice manipulation* was provided; that is, the reward that was given was totally independent from the choice the participant made. For example, in a dissertation by D. S. Cohen (1974), college students were either asked to choose between working on a word puzzle or a math decoding task or were assigned the word puzzle to work on. However, participants in both choice conditions were also randomly assigned to either receive a reward for their performance on the task or not. Thus, this study provided the effect of choice when no rewards were given as well as when an external reward was given. In other studies, participants made a choice regarding the reward as part of the choice manipulation. The presence of reward in this design was considered to be a *reward internal to the choice manipulation* because the choice being made was relevant to the reward the participant would receive. For example, Marinak (2004) allowed participants to choose the book they wanted as a reward for engaging in the activity. Finally, the majority of studies did not include the presence of rewards in any way. These were simply grouped as *no reward* studies.

Studies were grouped into five categories on the basis of the type of control group. In some studies, it was made apparent to control group participants that the experimenter or another person whom the participants did not know and was not personally significant to them had assigned them the task or aspects of the task. These control groups were categorized as a *nonsignificant-other choice control*. In other studies, participants in the control group were led to believe that someone personally significant to them, such as their mother, a teacher, or a classmate, had assigned them the task or aspects of the task. These control groups were categorized as a *significant-other choice control*. For example, in a study by Iyengar and Lepper (1999), some control participants were told that the experimenter had chosen their task for them, whereas other control participants were told that their mother had made the choice for them. Consequently, this study provided the effect of choice in comparison to a nonsignificant-other choice control, as well as the effect of choice in comparison to a significant-other choice control. When no-choice control participants were led to believe that the task or aspects of the task were randomly assigned to them because they were either told as much or because assignments were distributed randomly or assigned by a computer, the control group was categorized as a *random assignment choice control*. For example, in a study by Cordova and Lepper (1996), students were led to believe that the computer program they were working with simply randomly assigned task options to them. In some studies, control participants were made explicitly aware that they were not going to be given their choice. In some of these studies control participants were even asked to explicitly state their preference among options presented but were then assigned a task or aspects of a task not chosen. These control groups were categorized as a *denied choice control*. For example, in a study by Tafarodi, Milne, and Smith (1999), participants in both the choice condition and the denied choice condition stated their preferences for names to be used in a reading task. However, only choice participants received their selections; participants in the denied choice condition were randomly assigned names. Finally, in one instance (Courtney, 1984) participants were presented with alternatives and asked to make a choice, but the experimenter also provided reasons or incentives for doing a particular task or choosing particular aspects of a task. These control groups were categorized as a *suggested choice control*.

Effect size estimation. We used the standardized mean difference to estimate the effect of choice on measures of intrinsic motivation, performance, and other related measures. The *d*-index (J. Cohen, 1988) is a scale-free measure of the separation between two group means. Calculating the *d*-index for any comparison involves dividing the difference between the two group means by either their average standard deviation or by the standard deviation of the control group. This calculation results in a measure of the difference between the two group means expressed in terms of their common standard deviation or that of the untreated population. Thus, a *d*-index of 0.25 indicates that one-quarter standard deviation separates the two means. In the synthesis, we subtracted the mean of the no-choice condition from that of the choice condition and divided the difference by the average of their standard deviations. Thus, positive effect sizes indicate that participants given a choice had better motivation or related outcomes than did participants who were not given a choice. If available, we calculated overall as well as subgroup effect sizes based on the means, standard deviations, and sample sizes for outcome indicators. In cases for which the means and standard deviations were not accompanied by sample size information but a corresponding inference test was available, we estimated the effect size from the inference test. When means and standard deviations were presented with no sample sizes or inference tests, we assumed group sample sizes to be equal. Finally, if means and standard deviations were not available, we used the reported inferential statistics to estimate the *d*-indexes (see Rosenthal, 1994).

Coder reliability. Two graduate student coders extracted information from reports. Discrepancies were noted and discussed by the coders, and if agreement was not reached, a third researcher was consulted. A total of 8,895 codes were extracted by each coder. Discrepancies between the two coders were found in 256 instances, or for 2.88% of the codes. A small number of discrepancies occurred across almost all characteristics coded. The greatest number of discrepancies occurred for the type of control group code, perhaps due to the subjective nature of this judgment. However, the number of discrepancies that occurred was small, even for this code. Discrepancies in the codes for the type of control group were found in 24 instances and accounted for 9.4% of all discrepancies. Discrepancies in the actual effect size computed were found in 10 cases and accounted for 3.9% of all discrepancies. Discrepancies were resolved in all cases.

Because all studies were independently coded twice and all disagreements resolved through discussion or by a third independent coder, we did not calculate a formal estimate of reliability for this process. Evidence suggests that this process results in high reliability (Rosenthal, 1987). An appropriate estimate of reliability would have required three additional coders to undergo the same process on at least a subset of the studies so that we could compare each set of coders.

Methods of Data Integration

Before conducting any statistical integration of the effect sizes, we first counted the number of positive and negative effects. Next, we calculated the median and range of estimated relationships. Also, we examined the distribution of effect sizes to determine if any studies contained statistical outliers. Grubbs's (1950) test was applied (see also Barnett & Lewis, 1994), and if outliers were identified, these values were set at the value of their next nearest neighbor. Grubbs's test was repeated after this substitution to detect any additional outliers. If additional outliers were detected, these values were again set to their next nearest neighbor. This procedure was repeated until no outliers were detected. Further, this procedure was applied to every individual set of effect sizes. Thus, we initially tested for outliers using the set of overall effect sizes collapsed across subgroups, and then we repeated outlier tests for subgroup analyses in which effect sizes included in the data set were different from those in the overall effect size data set.

Both published and unpublished studies were included in the synthesis. However, there still exists the possibility that we did not obtain all studies that have investigated the relationship between choice and motivation. Therefore, we employed Duval and Tweedie's (2000a, 2000b) trim-and-fill procedure to test whether the distribution of effect sizes used in the analyses was consistent with that expected if the estimates were normally distributed. If the distribution of observed effect sizes was skewed, indicating a

possible bias created either by the study retrieval procedures or by data censoring on the part of authors, the trim-and-fill method provides a way to estimate the values from missing studies that need to be present to approximate a normal distribution. Then it imputes these missing values, permitting us to examine an estimate of the impact of data censoring on the observed distribution of effect sizes.

Calculating average effect sizes. A weighting procedure was used to calculate average effect sizes. Each independent effect size was first multiplied by the inverse of its variance. The sum of these products was then divided by the sum of the inverses. This weighting procedure is generally preferred because it gives greater weight to effect sizes based on larger samples because larger samples give more precise population estimates. Also, 95% confidence intervals (CIs) were calculated for weighted average effects. If the CI did not contain zero, then the null hypothesis that choice had no effect on the outcome was rejected.

Identifying independent hypothesis tests. One problem that arises in the calculation of effect sizes involves deciding what constitutes an independent estimate of effect. Here, we used a shifting unit of analysis approach (Cooper, 1998). In this procedure, each effect size associated with a study is first coded as if it were an independent estimate of the relationship. For example, if a single sample permitted comparisons of the effect of choice for both a behavioral and a self-report measure of intrinsic motivation, two separate effect sizes were calculated. However, for estimating the overall effect of choice, we averaged these two effect sizes prior to analysis so that the sample contributed only one effect size. To calculate the overall weighted mean and CI, we weighted this one effect size by the inverse of its variance (based primarily on sample size, which should about be equal for the two component effect sizes). However, in an analysis that examined the effect of choice on behavioral and self-report measures of intrinsic motivation separately, this sample would contribute one effect size to each estimate of a category mean effect size.

The shifting unit of analysis approach retains as much data as possible from each study while holding to a minimum any violations of the assumption that data points are independent. Also, because effect sizes are weighted by sample size in the calculation of averages, a study with many independent samples containing just a few participants will not have a larger impact on average effect size values than a study with only a single or a few large independent samples.

Tests for moderators of effects. We tested possible moderators of the relationship between choice and motivation using homogeneity analyses (Cooper & Hedges, 1994; Hedges & Olkin, 1985). Homogeneity analyses compare the amount of variance in an observed set of effect sizes with the amount of variance that would be expected by sampling error alone. The analyses can be carried out to determine whether the variance in a group of individual effect sizes varies more than predicted by sampling error. We tested the homogeneity of the set of effect sizes using a within-class goodness-of-fit statistic (Q_w), which has an approximate chi-square distribution with $k - 1$ degrees of freedom, where k equals the number of effect sizes. Thus, a significant Q_w statistic would indicate systematic variation among effect sizes and suggest that moderator variables be examined (Cooper, 1998). Similarly, homogeneity analyses can be used to determine whether multiple groups of average effect sizes vary more than predicted by sampling error. In this case, statistical differences among different categories of studies are tested by computing the between-class goodness-of-fit statistic (Q_b), which has a chi-square distribution with $p - 1$ degrees of freedom, where p equals the number of groups. A significant Q_b statistic indicates that average effect sizes vary between categories of the moderator variable more than predicted by sampling error alone. This strategy is analogous to testing for group mean differences in an analysis of variance or for linear effects in a multiple regression model.

Fixed and random error. Fixed-error models assume sampling error is due solely to differences among participants in the study. However, it is also possible to view studies as containing other random influences. If we believe that random variation in choice manipulations is a significant component of error, a random-error model should be used that takes into account this study-level variance in effect sizes (see Hedges & Vevea, 1998, for a discussion of fixed and random effects).

Rather than opt for a single model of error, we chose to apply both models to our data. We conducted all our analyses twice, once employing fixed-error assumptions and once employing random-error assumptions. Through conducting these sensitivity analyses (Greenhouse & Iyengar, 1994), we could examine the effects of different assumptions on the outcomes of the synthesis. We conducted all statistical analyses using the Comprehensive Meta-Analysis statistical software package (Version 2.1; Borenstein, Hedges, Higgins, & Rothstein, 2005).

Results

The literature search uncovered 41 studies that tested the effect of providing choice on intrinsic motivation. The 41 studies reported 290 separate effect sizes based on 46 separate samples. The authors, sample sizes, and effect sizes for these studies are listed in Table 2, along with other important study characteristics. Of the effect sizes, 165 represented the effect of choice on intrinsic motivation, 91 of which were overall effects collapsed across subgroups. Many studies also reported the effect of choice on other relevant outcomes including effort, task performance, subsequent learning, and perceived competence. The number of studies, samples, and separate effect sizes found for each outcome are listed in Table 3.

The 41 studies appeared between the years 1974 and 2004. The sample sizes ranged from 19 to 186. For each outcome, Grubbs's test was used to identify outliers within that set of effect sizes. Among effect sizes assessing the overall effect of choice on intrinsic motivation collapsed across subgroups, two outliers on the right side of the distribution ($d = 3.37$ and $d = 2.52$; both from Iyengar & Lepper, 1999) and one outlier from the left side of the distribution ($d = -1.04$; Swann & Pittman, 1977) were detected. All were Winsorized to their nearest neighbors ($d = 1.56$ and $d = -0.39$, respectively) and retained for further analyses. One outlier ($d = 3.81$; Iyengar and Lepper, 1999) among overall effects assessing effort was Winsorized to $d = 1.33$. One outlier ($d = 2.35$; Iyengar and Lepper, 1999) was detected among the overall effect sizes assessing task performance, and it was Winsorized to the nearest neighbor ($d = 1.27$) and returned for further analysis. One outlier ($d = 2.22$; Iyengar and Lepper, 1999) was detected

(*text continues on page 286*)

Table 2
Characteristics of Experimental Studies Included in the Meta-Analysis

Author (year)	Type of document	Sample	No. of choices	Options	Choice type	Control group type	Knowledge of alternatives	Design	Setting	Reward condition	Outcome	Measure type	Effect size
Abrahams, Study 1 (1988)	D	48[a] A	4 SC	IND	IR	RAC	UAW	Y	TUL	NRW	FCTS	B	+0.90
											I/E/L	S	+0.84
											TP	B	+0.18
Abrahams, Study 2 (1988)	D	42[b] A	4 SC	IND	IR	RAC	UAW	Y	TUL	NRW	FCTS	B	+0.51
											I/E/L	S	+0.12
											WTE	S	+0.41
Amabile & Gitomer (1984)	J	28 C	5 MC	10	IR	NSOC	AW	Y	LNS	NRW	FCTS	B	+0.79
											CR	S	+1.06
Bartleme (1983)	D	104 A	8 MC[c]	IND	IR	RAC	UAW	Y	TUL	CLPSD	E/L	S	+0.07
											E/L	S	−0.11
											E/L	S	+0.08
											WTE	S	−0.16
											TP	B	−0.05
											SL	B	−0.22
		34 A								NRW	E/L	S	+0.46
											E/L	S	−0.53
											E/L	S	+0.15
											WTE	S	+0.10
											TP	B	+0.17
											SL	B	−0.22
		70 A								RW[d]	E/L	S	−0.17
											E/L	S	−0.05
											E/L	S	+0.10
											WTE	S	−0.56
											TP	B	−0.17
											SL	B	−0.17
Becker (1997)	J	41 A	1	2	IR	NSOC	UAW	M	NS	NRW	GIM[e]	S	+0.58
											TP	B	+10.25
Cepe-Thomas (1992)	D	170 A	1	2	ACT	NSOC	UAW	M	NS	CLPSD	I	S	+0.13[f]
											WTE	S	−0.03[f]
											CR	S	+0.04[f]
		85 A								NRW	I	S	+0.28[f]
											WTE	S	+0.48[f]
											CR	S	+0.15[f]
		85 A								RW	I	S	−0.37[f]
											WTE	S	−0.09[f]
											CR	S	−0.07[f]
D. S. Cohen (1974)	D	104 A	1	2	ACT	NSOC	UAW	M	TUL	CLPSD	FCTS	B	−0.34
											E/L	S	+0.41
											I	S	+0.19
											WTE	S	+0.15
											TP	B	+0.37
											EF	S	+0.09
		26 A								NRW	FCTS	B	−0.22
											E/L	S	+0.13
											I	S	−0.49
											WTE	S	−0.32
											TP	B	+0.52
											EF	S	0.00
		78 A								RW	FCTS	B	−0.38
											E/L	S	+0.49
											I	S	+0.39
											WTE	S	+0.29
											TP	B	+0.31
											EF	S	+0.13
Cordova & Lepper (1996)	J	56[g] C	5 SC	VRD[h]	IIR	RAC	NR	NR	LNS	NRW	E/L	S	+0.76
											E/L	S	+0.93
											WTE	S	+0.79
											TP	B	+0.27
											PC	S	+0.41
											SL	B	+0.41
											PFC	B	+39.99

(*table continues*)

Table 2 (*continued*)

Author (year)	Type of document	Sample	No. of choices	Options	Choice type	Control group type	Knowledge of alternatives	Design	Setting	Reward condition	Outcome	Measure type	Effect size
Courtney (1984)	D	80 A	1	3	ACT	SGC	AW	M	TUL	NRW	I	S	−0.21
D'Ailly (2004)	J	130[i] C	8 MC	12	IR	CLPSD	CLPSD	NYM	LNS	NRW	I	S	+0.19
											EF	B	+0.09
											SL	B	−0.06
		68[j] C				SOC	AW				I	S	+0.34
											EF	B	+0.10
											SL	B	−0.01
		65[j] C				RAC	AW				I	S	0.00
											EF	B	+0.03
											SL	B	+0.03
		65[j] C				RAC	UAW				I	S	+0.19
											EF	B	+0.09
											SL	B	−0.19
Detweiler et al. (1996)	R	40 C	1	NR	V	NSOC	AW	NR	NR	NRW	FCTS	B	+0.16
Dwyer (1995)	J	34 A	12 SC[k]	NA[k]	IIR	NSOC	UAW	Y	LNS	NRW	I/E/L	S	+0.98
											PC	S	+0.97
											EF	S	+1.33
											P/T	S	−0.65
Feehan & Enzle (1991)	J	24[l] A	1	3	CRW	NSOC	AW	NYM	TUL	RW[m]	FCTS	B	+0.83
Flowerday & Schraw, Study 1[n] (2003)	J	45 A	1	2	ACT	NSOC	UAW	NYM	TUL	NRW	E/L	S	+0.52
											E/L	S	−0.02
											EF	S	−0.32
Flowerday & Schraw, Study 1[o] (2003)	J	39 A	1	2	ACT	NSOC	UAW	NYM	TUL	NRW	E/L	S	−0.39
											E/L	S	+0.20
											EF	S	−0.56
											TP	B	−0.25
Flowerday & Schraw, Study 2 (2003)	J	87 A	6 SC[p]	IND	IR	NSOC	UAW	NYM	TUL	NRW	I	S	−0.05
											E/L	S	+0.46
											E/L	S	+0.35
											SL	B	+0.09
											EF	S	−0.19
Flowerday et al., Study 1 (2004)	J	98 A	1	2	V	NSOC	UAW	NYM	TUL	NRW	I	S	+0.18
											SL	B	+0.20
Flowerday et al., Study 2 (2004)	J	106 A	1	2	V	NSOC	UAW	NYM	TUL	NRW	I	S	−0.13
											SL	B	+0.16
Hallschmid, Study 1 (1977)	D	50 A	1	5	ACT[q]	DC	AW	NYM	TUL	NRW	FCTS	B	+0.91
Hallschmid, Study 2 (1977)	D	144 A	CLPSD	CLPSD	CLPSD	CLPSD	AW	NYM	TUL	CLPSD	FCTS	B	+0.52
		58[r] A	1	5	ACT[q]	DC				NRW	FCTS	B	+1.15
		58[r] A	1	5	ACT[q]	DC				RW[m]	FCTS	B	+.11
		43[r] A	1	IND	CRW	NSOC				RW[m]	FCTS	B	−.07
		43[r] A	2 SC	5/IND	ACT[q]/ CRW	CLPSD				RW[m]	FCTS	B	+.38
		29[r] A	2 SC	5/IND	ACT[q]/ CRW	SMC				RW[m]	FCTS	B	+.43
Iyengar & Lepper, Study 1[s] (1999)	J	53 C	2 SC	6/6	V/IIR	CLPSD	AW	Y	LNS	NRW	FCTS	B	+2.52
											TP	B	+2.35
		36[j] C				NSOC					FCTS	B	+2.58
											TP	B	+2.30
		35[j] C				SOC					FCTS	B	+2.74
											TP	B	+2.39

Table 2 (*continued*)

Author (year)	Type of document	Sample	No. of choices	Options	Choice type	Control group type	Knowledge of alternatives	Design	Setting	Reward condition	Outcome	Measure type	Effect size
Iyengar & Lepper, Study 1[t] (1999)	J	52 C	2 SC	6/6	V/IIR	CLPSD	AW	Y	LNS	NRW	FCTS	B	+0.01
											TP	B	−0.03
		35[j] C				NSOC					FCTS	B	+1.15
											TP	B	+0.91
		34[j] C				SOC					FCTS	B	−1.06
											TP	B	−1.15
Iyengar & Lepper, Study 2[s] (1999)	J	41 C	4 SC	4	IIR	CLPSD	AW	Y	LNS	NRW	E/L	S	+1.56
											WTE	S	+3.37
											TP	B	+1.27
											EF	B	+3.81
											SL	B	+2.22
											PFC	B	+1.41
		27[j] C				NSOC					E/L	S	+1.33
											WTE	S	+3.97
											TP	B	+1.20
											EF	B	+3.85
											SL	B	+1.98
											PFC	B	+1.03
		28[j] C				SOC					E/L	S	+1.74
											WTE	S	+3.42
											TP	B	+1.31
											EF	B	+3.18
											SL	B	+2.12
											PFC	B	+1.67
Iyengar & Lepper, Study 2[t] (1999)	J	47 C	4 SC	4	IIR	CLPSD	AW	Y	LNS	NRW	E/L	S	+0.19
											WTE	S	+0.35
											TP	B	−0.10
											EF	B	−0.07
											SL	B	+0.29
											PFC	B	−0.59
		31[j] C				NSOC					E/L	S	+1.42
											WTE	S	+1.76
											TP	B	+0.48
											EF	B	+2.22
											SL	B	+1.44
											PFC	B	+0.45
		32[j] C				SOC					E/L	S	−1.07
											WTE	S	−1.19
											TP	B	−0.69
											EF	B	+1.76
											SL	B	−0.66
											PFC	B	−1.72
Jagacinski (1978)	D	77 A	1	2	ACT	NSOC	AW	M	TUL	NRW	WTE	S	+0.13
											PC	S	+0.43
Keefer, (1988)	D	48 A	2 SC	4/3	V/IR	NSOC	UAW	Y	TUL	MX[v]	FCTS	B	+0.59
Keefer, (1988)	D	41 A	2 SC	4/3	V/IR	NSOC	UAW	Y	TUL	MX[v]	FCTS	B	+0.51
Kingstone (1985)	MT	62[l] A	1	2	CRW	NSOC	UAW	NYM	TUL	RW	FCTS	B	+0.47
											E/L	S	+0.33
											WTE	S	+0.32
Landsteward (1991)	MT	40 A	1	3	IR	NSOC	UAW	NYM	TUL	NRW	FCTS	B	+0.06
											FCE	B	+0.03
											GIM[x]	S	+0.22
											I/E/L[x]	S	+0.17
											WTE	S	+0.06
											EF[x]	S	+0.04
											TP	B	−0.07
											SL	B	+0.03
											P/T[x]	S	−0.08

(*table continues*)

Table 2 (*continued*)

Author (year)	Type of document	Sample	No. of choices	Options	Choice type	Control group type	Knowledge of alternatives	Design	Setting	Reward condition	Outcome	Measure type	Effect size
Margolis & Mynatt (1986)	J	39 C	2 SC	CLPSD	CLPSD	NSOC	UAW	Y	TUL	CLPSD	FCTS[x]	B	+0.23
											I[x]	S	+0.70
		20 C		4/IND	V/IR					NRW	FCTS[x]	B	−0.02
											I[x]	S	0.00
		19 C		IND	CRW/IR					RW	FCTS[x]	B	+0.49
											I[x]	S	+1.03
Marinak (2004)	D	60[l] C	2 SC[y]	6/25	V/CRW	SMC	AW	NYM	LNS	RW	FCTS	B	+0.09
											FCE	B	+0.15
											TP	B	+0.12
New (1978)	D	96 A	1	6	ACT	RAC	AW	M	TUL	MX[v]	FCTS	B	−0.02
											WTE	S	+0.14
											SF	S	+0.08
Prusak et al. (2004)	J	42 C	2 SC	3/IND	ACT/IR	SOC	UAW	NR	NS	NRW	I/E/L[x]	S	+0.88
Reeve et al., Study 1 (2003)	J	186 A	1	6	V	NSOC	CLPSD	Y	TUL	NRW	FCTS	B	−0.02
											I/E/L	S	+0.16
		124[j] A					AW				FCTS	B	−0.02
											I/E/L	S	+0.22
		124[j] A					UAW				FCTS	B	−0.03
											I/E/L	S	+0.10
Reeve et al., Study 2 (2003)	J	66 A	CLPSD	CLPSD	CLPSD	NSOC	AW	Y	TUL	NRW	CIM	B/S	+0.62
		44[z] A	3 MC	4	V						CIM	B/S	+0.19
		44[z] A	3 MC + 3 SC	4/IND	V/IR						CIM	B/S	+1.04
Schraw et al., Study 1 (1998)	J	56 A	1	3	V	CLPSD	CLPSD	M	TUL	NRW	I	S	+0.33
											E/L	S	+0.69
											E/L	S	+0.50
											EF	S	+0.38
											SL	B	+0.04
											SL	S	+0.37
		38[j] A				DC	AW				I	S	+0.19
											E/L	S	+0.70
											E/L	S	+0.48
											EF	S	+0.45
											SL	B	+0.15
											SL	S	+0.76
		35[j] A				NSOC	UAW				I	S	+0.46
											E/L	S	+0.74
											E/L	S	+1.28
											EF	S	+0.26
											SL	B	−0.10
											SL	S	+0.07
Schraw et al., Study 2 (1998)	J	121 A	1	2	V	DC	AW	M	TUL	NRW	I	S	+0.57
											E/L	S	+0.33
											E/L	S	+0.57
											SL	B	+0.04
											SL	S	+0.17
											EF	S	+0.22
Swann & Pittman, Study 1 (1977)	J	60 C	1	4	ACT	DC	AW	M	LNS	CLPSD	FCE	B	+0.58
		20 C								NRW	FCE	B	+1.53
		40 C								RW[m]	FCE	B	+0.14
Swann & Pittman, Study 2 (1977)	J	26[aa] C	1	4	ACT	NSOC	UAW	M	LNS	NRW	FCE	B	−1.04

Table 2 (*continued*)

Author (year)	Type of document	Sample	No. of choices	Options	Choice type	Control group type	Knowledge of alternatives	Design	Setting	Reward condition	Outcome	Measure type	Effect size
Tafarodi et al., Study 1[ab] (2002)	J	52[ac] A	6 SC	6	IIR	CLPSD	CLPSD	Y	TUL	NRW	I	S	+0.50
											E/L	S	+0.82
											SL	B	−0.04
											PC	S	+0.60
											PC	S	+0.74
		35[j] A				DC	AW				I	S	+0.44
											E/L	S	+0.51
											SL	B	+0.01
											PC	S	+0.66
											PC	S	+1.12
		35[j] A				NSOC	UAW				I	S	+0.62
											E/L	S	+1.16
											SL	B	−0.08
											PC	S	+0.69
											PC	S	+0.58
Tafarodi et al., Study 1[ad] (2002)	J	55[ac] A	6 SC	6	IIR	CLPSD	CLPSD	Y	TUL	NRW	I	S	−0.20
											E/L	S	+0.22
											SL	B	−0.51
											PC	S	+0.80
											PC	S	+0.79
		37[j] A				DC	AW				I	S	−0.32
											E/L	S	−0.31
											SL	B	−0.39
											PC	S	+0.91
											PC	S	+1.14
		37[j] A				NSOC	UAW				I	S	−0.09
											E/L	S	+0.64
											SL	B	−0.67
											PC	S	+0.70
											PC	S	+0.59
Tafarodi et al. (1999)	J	43 A	13 SC	6	IIR	CLPSD	CLPSD	Y	TUL	NRW	I	S	+0.56
											E/L	S	+0.09
											PC	S	+1.02
											PC	S	+1.35
											SL	B	+0.52
		28[j] A				DC	AW				I	S	+0.60
											E/L	S	−0.21
											PC	S	+1.19
											PC	S	+1.42
											SL	B	+0.68
		29[j] A				NSOC	UAW				I	S	+0.56
											E/L	S	+0.43
											PC	S	+0.92
											PC	S	+1.26
											SL	B	+0.39
Thompson & Wankel (1980)	J	36 A	NR[ae]	NR	V	SOC	AW	Y	NS	NRW	WTE	S	+0.75
West (1993)	D	80 A	28 MC[af]	IND	IR	MX[ag]	AW	Y	TUL	NRW	E/L	S	+0.52
											E/L	S	+0.35
											E/L	S	+0.51
											I	B	+0.46
											EF	B	+1.23
											TP	S	+0.75
											PC	S	+0.19
Wheeler (1992)	D	60 A	14 SC[ah]	NA[ah]	IIR	NSOC	UAW	Y	NS	NRW	I/E/L	S	+0.44
											PC	S	+0.14
											EF	S	+0.42
											P/T	S	+0.38

(*table continues*)

Table 2 (*continued*)

Author (year)	Type of document	Sample	No. of choices	Options	Choice type	Control group type	Knowledge of alternatives	Design	Setting	Reward condition	Outcome	Measure type	Effect size
Zuckerman et al. (1978)	J	80 A	3 MC + 3 SC	6/IND	V/IR	NSOC	UAW	Y	TUL	NRW	FCTS	B	+0.48
											WTE	S	+0.64

Note. For studies in which there were a number of subgroups, both subgroup effect sizes and overall effect sizes collapsed across subgroups are presented. The overall effect sizes collapsed across subgroups appear in the top of a row for every study with multiple subgroups. Note that overall effect sizes are not equal to taking an average of the subgroup effects. This is because we computed overall effect sizes using means, standard deviations, or *t* or *F* tests provided in the original article rather than by averaging across the effect sizes of subgroups.
D = dissertation; J = journal article; MT = master's thesis; R = report; A = adults; C = children; MC = multiple choices from a list of options; SC = successive choices; IND = indeterminate number of options; ACT = choice of activities; V = choice of versions; IR = instructionally relevant choice; IIR = instructionally irrelevant choice; CRW = choice of rewards; MX = mixed; SOC = significant-other choice control; NSOC = nonsignificant-other choice control; RAC = random assignment control; DC = denied choice; SGC = suggested choice control; SMC = some choice control; AW = aware of alternatives; UAW = unaware of alternatives; Y = yoked; M = matched; NYM = no yoking or matching; TUL = traditional university laboratory; LNS = laboratory within a natural setting; NS = natural setting; NRW = no reward; RW = reward; FCTS = free-choice time spent; FCE = free choice to engage in activity; I = interest; E/L = enjoyment/liking; WTE = willingness to engage in task again; I/E/L = interest, enjoyment, or liking; GIM = general intrinsic motivation measure; CIM = combined intrinsic motivation measure; TP = task performance; EF = effort; SL = subsequent learning; CR = creativity; PFC = preference for challenge; PC = perceived competence; P/T = pressure or tension; SF = satisfaction; B = behavioral; S = self-report; NA = not applicable; NR = not reported; VRD = varied; CLPSD = collapsed condition.
[a] A no-goal control group was excluded. The effect size reflects a comparison between choice of goal and no choice of goal conditions. [b] Three no-goal groups were excluded. The effect size reflects a comparison between choice of goal and no choice of goal conditions. [c] Participants decided the order in which to work on nine puzzles. [d] This study employed a factorial design with two levels of a choice factor (choice, no choice) and three levels of reward (no reward, minimum competency reward, performance reward). However, effect sizes were collapsed across the three types of reward. [e] This measure of intrinsic motivation was a combination of interest and feelings of being able to look at bankruptcy prediction in a new way. [f] Comparisons were collapsed across awareness of research participation conditions. [g] No-fantasy control group excluded. The effect size reflects a comparison between choice of fantasy aspects and no choice of fantasy aspects conditions. [h] Two choices had only four options. For the other choices, options were not provided, and there was an infinite number of possible decisions the participant could make. [i] This study also tested the effect of choice in a sample of fifth and sixth grade students from Taiwan, which was excluded. [j] This sample overlaps with other subgroup samples because a single-choice group was compared to various control groups. [k] Participants in the choice condition rated the extent to which they would like to hear each of 12 music selections on a 5-point Likert scale. Choice participants were told the music played during the aerobics class would reflect theirs and other participants' preferences. In this way, choices were given on a group aggregate basis. Control group participants also heard the same music. [l] Participants in a no-reward control condition were excluded. The effect size reflects a comparison between choice of reward and no choice of reward participants. [m] Effect sizes were collapsed across reward condition. [n] Sample was divided by task completed. This sample completed the essay task. [o] Sample was divided by task completed. This sample completed the crossword puzzle. [p] Participants were allowed to choose the pace at which they worked on each of six sections of materials packet. [q] Choice participants received their preferred task on the basis of their rankings. Choice participants ranked all five options. No-choice participants did not receive a preferred task. [r] This sample overlaps with other subgroup samples. [s] Participants were divided into two samples by ethnicity and analyzed separately by the authors. This sample was Caucasian American. [t] Participants were divided into two samples by ethnicity and analyzed separately by the authors. This sample was Asian American. [u] Effect sizes for Keefer (1988) could be computed separately for only two sets of participants. This sample was labeled as "high into" the task. [v] Collapsed across reward and no-reward conditions because effect sizes could not be isolated for each reward condition. [w] Effect sizes for Keefer (1988) could be computed separately for only two sets of participants. This sample was labeled as "low into" the task. [x] Effect sizes are averaged across multiple time points. [y] Both choice and no-choice participants received a choice of reading material during the experimental phase. Only choice of reward varied among conditions. [z] This sample overlaps with other subgroup samples because multiple-choice groups were compared to a single control group. [aa] Participants in three choice and reward conditions were excluded because there were no corresponding no-choice and reward conditions, and analyses were restricted to those participants who chose or were assigned the drawing activity. [ab] Participants were divided and analyzed separately by gender. This sample is all female. [ac] Participants in impersonal choice conditions were excluded because they were asked to choose on the basis of what others would choose. [ad] Participants were divided and analyzed separately by gender. This sample is all male. [ae] Choice participants were asked to rank preferences for exercises within each exercise group and then were told they were getting their preferences. [af] Participants were allowed to choose the order of difficulty (easy, moderate, hard) for the puzzles on which they worked. All participants (choice and control) got to choose the order in which they worked on puzzles within each level of difficulty (nine puzzles at each level). [ag] Author began with multiple control groups that were collapsed into a single no-choice control group. One of the control groups was allowed to choose what color puzzle pieces to work with for the task. In another control condition participants were given a choice but encouraged to pick a particular option. [ah] Participants in the choice condition rated the extent to which they would like to hear each of 14 music selections on a 6-point Likert scale. Choice participants were told the music played during the aerobics class would reflect theirs and other participants' preferences. In this way, choices were given on a group aggregate basis. Control group participants also heard the same music.

among overall effect sizes assessing subsequent learning. This outlier was Winsorized to $d = 0.52$. One outlier ($d = 39.99$) from Cordova and Lepper (1996) was detected among overall effect sizes assessing preference for challenge. This outlier was Winsorized to its nearest neighbor ($d = 1.41$) and retained for further analysis. No outliers were detected among overall effect sizes assessing pressure or tension or perceived competence. Because there were fewer than three effect sizes contributing to the average weighted effects, a test of outliers was not conducted for effect sizes assessing creativity or satisfaction.

Overall Effects of Choice

First, we examined the overall effect of choice on each of the nine outcomes (see Table 4). Of the 91 overall effect sizes assessing the effect of choice on intrinsic motivation, 78 were in a

Table 3
Number of Effects Found by Outcome

Outcome	No. of studies	No. of samples	Total no. of effect sizes (both overall and subgroup effect sizes)	No. of overall effect sizes (no subgroup effect sizes)
Total	41	46	290	155
Intrinsic motivation	41	46	165	91
Effort	11	13	25	14
Task performance	11	13	25	13
Subsequent learning	12	14	35	16
Perceived competence	7	8	23	11
Preference for challenge	2	3	7	3
Pressure or tension	3	3	4	4
Creativity	2	2	4	2
Satisfaction	1	1	1	1

positive direction and 13 in a negative direction. The effects ranged from $d = -0.39$ to 1.56 (after Winsorization). The weighted average d was 0.30 under a fixed-error (FE) model with a 95% CI from 0.25 to 0.35. The weighted average d was 0.36 under a random-error (RE) model with a 95% CI from 0.27 to 0.46. Therefore, the hypothesis that the effect of choice on intrinsic motivation is equal to zero could be rejected under both fixed- and random-error models. Additionally, the tests of the distribution of effect sizes revealed that we could reject the hypothesis that the effects were estimating the same underlying population value, $Q(45) = 146.30$, $p < .001$.

The trim-and-fill analyses were conducted in several different ways. We performed the analyses looking for asymmetry using both fixed- and random-error models (see Borenstein et al., 2005) while we searched for possible missing effects on the left side of the distribution (those that would reduce the size of the positive average d). Using a fixed-effects model, we found evidence that 11 effect sizes might have been missing. Imputing these values would change the mean effect to $d = 0.21$ (95% CI = 0.16, 0.26) under fixed effects and $d = 0.22$ (95% CI = 0.11, 0.33) under random effects. Using the random-effects model, we found evidence that 10 effect sizes might have been missing. Imputing these values would change the mean effect to $d = 0.22$ (95% CI = 0.17, 0.27) under fixed effects and $d = 0.24$ (95% CI = 0.13, 0.35) under random effects. Thus, even when we tested for possible data censoring, the effect of choice on intrinsic motivation was positive and significantly different from zero, although its magnitude shrank by about one third.

Nine of the 14 overall effect sizes assessing the effect of choice on effort were in a positive direction, and 5 were in a negative direction, ranging from $d = -0.56$ to 1.33 (after Winsorization). The weighted average d was 0.22 (95% CI = 0.08, 0.35) under a fixed-error model and 0.28 (95% CI = 0.01, 0.56) under a random-error model, $Q(12) = 48.06$, $p < .001$. Trim-and-fill analyses indicated that no additional effects were imputed under either a fixed- or a random-effects model.

Eight of the 13 overall effect sizes assessing the effect of choice on task performance were in a positive direction, and 5 were in a negative direction. The effects ranged from $d = -0.25$ to 1.27 (after Winsorization). The weighted average d was significantly different from zero under both models (FE: $d = 0.32$, 95% CI = 0.17, 0.47; RE: $d = 0.36$, 95% CI = 0.09, 0.63), $Q(12) = 38.73$, $p < .001$. No additional effects were imputed when we conducted trim-and-fill analyses using either a fixed- or a random-effects model.

Of the 16 overall effect sizes assessing the effect of choice on subsequent learning, 12 were in a positive direction, and 4 were in a negative direction, ranging from $d = -0.51$ to 0.52 (after

Table 4
Results of Analyses Examining the Overall Effect of Choice on All Outcomes

Outcome	k	d	95% confidence interval		Q
			Low estimate	High estimate	
Intrinsic motivation	46	0.30**(0.36)**	0.25(0.27)	0.35(0.46)	146.30**
Effort	13	0.22**(0.28)*	0.08(0.01)	0.35(0.56)	48.06**
Task performance	13	0.32**(0.36)**	0.17(0.09)	0.47(0.63)	38.73**
Subsequent learning	14	0.10(0.10)	−0.02(−0.02)	0.21(0.21)	13.37
Perceived competence	8	0.59**(0.59)**	0.42(0.34)	0.76(0.84)	14.34*
Preference for challenge	3	0.71*(0.74)	0.34(−0.59)	10.07(2.07)	26.35**
Pressure or tension	3	−0.03(−0.08)	−0.33(−0.60)	0.27(0.45)	5.63
Creativity	2	0.17(0.48)	−0.11(−0.51)	0.45(1.47)	5.58*
Satisfaction	1	0.08(0.08)	−0.32(−0.32)	0.48(0.48)	0.00

Note. Fixed-effects estimates are presented outside parentheses and random-effects estimates are within parentheses. On the basis of these overall results, only intrinsic motivation was examined for moderator effects. Although the effect of choice demonstrated a significant amount of heterogeneity (Q) for other outcomes as well, moderator analyses were not conducted for those outcomes with fewer than 15 samples contributing to the composite effect.
* $p < .05$. ** $p < .01$.

Winsorization). The weighted average d was not significantly different from zero under either fixed- or random-effects models (FE: $d = 0.10$, 95% CI = −0.02, 0.21; RE: $d = 0.10$, 95% CI = −0.02, 0.21), $Q(13) = 13.37$, $p = .42$, although it is clear the effect approached statistical significance. While searching for possible missing effects on the left side of the distribution, we imputed two additional effects using both a fixed- and a random-effects model. Imputing these values would change the mean effect to $d = 0.05$ (95% CI = −0.07, 0.16) under fixed effects and $d = 0.04$ (95% CI = −0.08, 0.17) under random effects.

All 11 of the overall effect sizes assessing the effect of choice on perceived competence were in a positive direction. The effects ranged from $d = 0.14$ to 1.35. The weighted average d was 0.59 and was significantly different from zero under both fixed- and random-error models (FE: 95% CI = 0.42, 0.76; RE: 95% CI = 0.34, 0.84), $Q(7) = 14.34$, $p < .05$. While searching for possible missing effects on the left side of the distribution, we found evidence that three effect sizes might have been missing under a fixed-effects model. Imputing these values would change the mean effect to $d = 0.47$ (95% CI = 0.32, 0.63) under fixed effects and $d = 0.49$ (95% CI = 0.25, 0.72) under random effects. Under the random-effects model, no additional effects were imputed.

Of the three overall effect sizes assessing the effect of choice on preference for challenge, two were in a positive direction, and one was in a negative direction. The effects ranged from $d = -0.59$ to 1.41 (after Winsorization). The weighted average d was 0.71 (95% CI = 0.34, 1.07) under a fixed-error model and 0.74 (95% CI = −0.59, 2.07) under a random-error model, $Q(2) = 26.35$, $p < .001$. Therefore, the hypothesis that the effect of choice on preference for challenge is equal to zero could be rejected under a fixed-effects model but not under a random-effects model.

Two of the four overall effect sizes assessing the effect of choice on pressure or tension were in a positive direction, and two were negative. The effects ranged from $d = -0.65$ to 0.38. The weighted average d was not significant under either fixed- or random-error models (FE: $d = -0.03$, 95% CI = −0.33, 0.27; RE: $d = -0.08$, 95% CI = −0.60, 0.45), $Q(2) = 5.63$, $p > .05$.

Both effect sizes assessing the effect of choice on creativity with the activity were positive ($d = 0.04$ and $d = 1.06$). The weighted average of these two ds was not significant under either model (FE: $d = 0.17$, 95% CI = −0.11, 0.45; RE: $d = 0.48$, 95% CI = −0.51, 1.47), $Q(1) = 5.58$, $p < .05$. With so few effect sizes, trim-and-fill analyses were not conducted on preference for challenge, pressure or tension, and creativity outcomes. Finally, the single effect size assessing the effect of choice on satisfaction with the task was 0.08 (95% CI = −0.32, 0.48) under both fixed- and random-error assumptions.

Next, moderators of the effect of choice were assessed for intrinsic motivation outcomes. Although the effects of choice on effort, task performance, perceived competence, preference for challenge, and creativity were also found to be statistically heterogeneous, moderator analyses were not conducted on these outcomes due to the small number of contributing studies for these outcomes. The small number of effect sizes contributing to group effects raised concerns about the stability of the average weighted group effects. Also, we required that the effect of choice on intrinsic motivation be assessed in order for a study to be included. Therefore, studies in which the effect of choice was assessed for related nonmotivation outcomes but not for intrinsic motivation itself were excluded. Thus, looking for moderators of the effect of choice for these nonmotivation outcomes would be an unfair test, given that the database on which these assessments would be made was necessarily incomplete. Finally, although we did not test for moderators for the effect of choice on outcomes other than intrinsic motivation, the pattern of findings is expected to be similar to that found for intrinsic motivation.

Intrinsic Motivation Moderator Analyses

We conducted moderator analyses of the effect of providing choice on intrinsic motivation using 12 moderators of theoretical and methodological interest. Table 5 presents these results.

Publication status. First, we examined the association between the magnitude of effect sizes and the publication status of the study report. Effects from published reports ($k = 28$; FE: $d = 0.41$, 95% CI = 0.33, 0.48; RE: $d = 0.46$, 95% CI = 0.31, 0.60) were significantly different than those from unpublished sources ($k = 18$; FE: $d = 0.20$, 95% CI = 0.13, 0.28; RE: $d = 0.26$, 95% CI = 0.14, 0.38) under both a fixed-error model, $Q(1) = 14.98$, $p < .001$, and a random-error model, $Q(1) = 4.04$, $p < .05$.

Choice type. Because the choice type moderator analysis involved replacing some overall effect sizes collapsed across subgroups with effect sizes for choice type subgroups, Grubbs's outlier test was conducted again. No new outliers were detected. Several studies (Iyengar & Lepper, 1999, Study 1; Keefer, 1988; Margolis & Mynatt, 1986; Marinak, 2004; Prusak, Treasure, Darst, & Pangrazi, 2004; Zuckerman et al., 1978) were excluded from this analysis because choice manipulations involved a combination of different types.

The average weighted effect of choice on intrinsic motivation significantly varied for different types of choice manipulations under fixed-error assumptions, $Q(4) = 21.61$, $p < .001$, but not under random-error assumptions, $Q(4) = 5.63$, $p = .23$. We then proceeded to conduct pairwise comparisons under fixed-effects assumptions only. The largest effect was for manipulations that involved an instructionally irrelevant choice ($k = 8$; $d = 0.59$, 95% CI = 0.43, 0.74). Instructionally irrelevant choices were significantly different from choice manipulations involving choice of activities ($k = 11$; $d = 0.16$, 95% CI = 0.06, 0.26), $Q(1) = 20.83$, $p < .001$, choice of versions ($k = 8$; $d = 0.27$, 95% CI = 0.15, 0.38), $Q(1) = 10.53$, $p < .001$, and instructionally relevant choices ($k = 9$; $d = 0.24$, 95% CI = 0.14, 0.34), $Q(1) = 13.61$, $p < .01$. Instructionally irrelevant choices were not significantly different from manipulations involving choice of rewards ($k = 3$; $d = 0.35$, 95% CI = 0.09, 0.60), $Q(1) = 2.60$, $p = .11$. No significant differences were found in average weighted effects between manipulations involving choice of activities, choice of rewards, choice of versions, or instructionally relevant choices.

Number of options per choice. Studies were divided into four groups on the basis of the number of options among which participants chose: studies in which participants were provided with two, three to five, or more than five options per choice, and those for which predetermined options were not specifically presented to the participants but the nature of the choice dictated that the participants had a large, indeterminate number of options. As an example of this last category, Abrahams (1988) asked participants to choose a goal for their performance on a

Table 5
Results of Moderator Analyses Examining the Effect of Choice on Intrinsic Motivation

Moderator	*k*	*d*	95% confidence interval		Q_b
			Low estimate	High estimate	
Publication type					14.98** (4.04)*
Published	28	0.41** (0.46)**	0.33 (0.31)	0.48 (0.60)	
Unpublished	18	0.20** (0.26)**	0.13 (0.14)	0.28 (0.38)	
Choice type					21.61** (5.63)
Choice of activities	11	0.16** (0.20)**	0.06 (0.04)	0.26 (0.35)	
Choice of versions	8	0.27** (0.26)**	0.15 (0.06)	0.38 (0.46)	
Instructionally irrelevant	8	0.59** (0.61)**	0.43 (0.29)	0.74 (0.94)	
Instructionally relevant	9	0.24** (0.33)**	0.14 (0.14)	0.34 (0.51)	
Choice of reward	3	0.35** (0.34)	0.09 (−0.03)	0.60 (0.71)	
No. of options per choice					5.62† (3.29)
Two	10	0.20** (0.19)**	0.10 (0.05)	0.29 (0.33)	
Three to five	13	0.38** (0.43)**	0.26 (0.16)	0.50 (0.69)	
More than five	18	0.26** (0.34)**	0.18 (0.19)	0.34 (0.49)	
No. of choices (Analysis 1)					32.01** (11.15)**
One choice	21	0.21** (0.23)**	0.14 (0.12)	0.28 (0.33)	
Multiple choices	5	0.18** (0.25)	0.04 (−0.02)	0.31 (0.53)	
Successive choices	18	0.54** (0.58)**	0.44 (0.40)	0.64 (0.77)	
No. of choices (Analysis 2)					27.66** (10.28)**
One choice	21	0.21** (0.23)**	0.14 (0.12)	0.28 (0.33)	
Two to four choices	12	0.61** (0.63)**	0.48 (0.38)	0.75 (0.88)	
More than five choices	12	0.32** (0.45)**	0.22 (0.23)	0.43 (0.66)	
Reward					24.41** (12.16)**
No reward	40	0.35** (0.40)**	0.29 (0.27)	0.41 (0.52)	
Reward internal to choice manipulation	5	0.35** (0.36)**	0.16 (0.08)	0.54 (0.64)	
Reward external to choice manipulation	5	−0.01 (−0.02)	−0.15 (−0.22)	0.12 (0.18)	
Control group					6.73* (0.12)
No choice	38	0.28** (0.43)**	0.23 (0.29)	0.34 (0.56)	
Significant other chose	7	0.49** (0.59)	0.28 (−0.37)	0.70 (1.54)	
Denied choice	8	0.43** (0.42)**	0.30 (0.21)	0.57 (0.62)	
Control group knowledge of alternatives					4.89* (0.77)
Unaware	26	0.24** (0.31)**	0.18 (0.19)	0.31 (0.44)	
Aware	26	0.36** (0.40)**	0.28 (0.25)	0.44 (0.55)	
Sample					17.76** (2.72)†
Adults	33	0.25** (0.31)**	0.20 (0.21)	0.31 (0.40)	
Children	13	0.55** (0.55)**	0.42 (0.28)	0.67 (0.81)	
Measurement type					0.05 (0.05)
Behavioral	22	0.29** (0.39)**	0.20 (0.22)	0.39 (0.56)	
Self-report	32	0.31** (0.36)**	0.24 (0.25)	0.37 (0.48)	
Outcome measure					5.76 (3.73)
Free choice	21	0.30** (0.36)**	0.19 (0.18)	0.40 (0.55)	
Enjoyment or liking	16	0.36** (0.40)**	0.27 (0.24)	0.46 (0.56)	
Interest	14	0.18** (0.19)**	0.06 (0.04)	0.29 (0.35)	
Willingness to engage again	13	0.28** (0.34)**	0.15 (0.14)	0.41 (0.55)	
Study design					7.40* (7.40)*
No yoking/matching	12	0.23** (0.24)**	0.13 (0.11)	0.33 (0.38)	
Matching with reduced choice	10	0.20** (0.20)**	0.11 (0.03)	0.30 (0.37)	
Yoked	21	0.37** (0.51)**	0.28 (0.34)	0.45 (0.69)	
Setting					13.19** (3.43)
University lab	29	0.26** (0.30)**	0.20 (0.20)	0.32 (0.40)	
Lab within natural setting	11	0.55** (0.59)**	0.41 (0.25)	0.69 (0.92)	
Natural setting	5	0.33** (0.51)**	0.17 (0.11)	0.49 (0.91)	

Note. Fixed-effects values are presented outside of parentheses and random-effects values are within parentheses.
† $p < .10$. * $p < .05$. ** $p < .01$.

word maze task. Predetermined options were not provided; rather, the participants could choose any possible score as a goal. Grubbs's outlier test was conducted on the number of options moderator analysis effect size data set. No new outliers were detected. Several studies (Cordova & Lepper, 1996; Deweiler, Mendoza, & Lepper, 1996; Prusak et al., 2004; Thompson & Wankel, 1980) were excluded from this moderator analysis because either the number of options provided was unclear or multiple choices were made within a single choice manipulation and the number of options provided varied across different choices. Two additional studies (Dwyer, 1995; Wheeler, 1992) were excluded because participants in the choice condition rated the extent to which they would like to hear each possible music selection on a Likert scale, rather than explicitly

picking a selection among options. Participants were then given their highest rated selections.

First, we tested whether choice conditions in which participants were given more than five options ($k = 10$) were distinct from conditions in which participants had a large, indeterminate number of options ($k = 7$). Under both fixed- and random-error assumptions, the average weighted effect of choice on intrinsic motivation when more than five options were provided (FE: $d = 0.21$, 95% CI = 0.09, 0.32; RE: $d = 0.30$, 95% CI = 0.08, 0.53) was not significantly different from the average weighted effect of choice when a large, indeterminate number of options was available (FE: $d = 0.27$, 95% CI = 0.16, 0.38, RE: $d = 0.36$, 95% CI = 0.11, 0.61), FE: $Q(1) = 0.61$, $p = .43$; RE: $Q(1) = 0.11$, $p = .74$. Therefore, these two categories were collapsed into the more than five options category. This analysis revealed a nearly significant difference in the effect of choice on intrinsic motivation depending on whether participants were given two options ($k = 10$), between three and five options ($k = 13$), or more than five options ($k = 18$)[4] under either a fixed-error model, $Q(2) = 5.62$, $p < .06$, or a random-error model, $Q(2) = 3.29$, $p = .20$, favoring the effect of choice when three to five options are provided.

Number of choices. The association between the number of choices participants in the experimental condition made in a single choice-manipulation and the magnitude of the effect of choice was assessed in several ways. First, we categorized studies into those in which the choice manipulation consisted of a single choice, those in which participants made multiple choices from a single list of possible choices, and those in which participants were given successive choices such that they chose one option from a list of options multiple times. Also, we categorized studies simply by the actual number of choices the participants made. An outlier test was conducted on the number of choices moderator analyses data set. No new outliers were detected.

For the first total number of choices moderator analysis, several studies (Marinak, 2004; Thompson & Wankel, 1980; Zuckerman et al., 1978) were excluded because either relevant information was not reported or, when more than one choice was provided, some choices were given successively, while for other choices multiple options from a single list of options were selected. The magnitude of the effect of choice on intrinsic motivation varied significantly depending on whether participants were given a single choice ($k = 21$), multiple choices from a single list of options ($k = 5$), or multiple successive choices ($k = 18$) under both models, FE: $Q(2) = 32.01$, $p < .001$; RE: $Q(2) = 11.15$, $p < .005$. Under both fixed- and random-effects assumptions, the average effect of choice when participants were given multiple successive choices (FE: $d = 0.54$, 95% CI = 0.44, 0.64; RE: $d = 0.58$, 95% CI = 0.40, 0.77) was greater than when participants were given a single choice (FE: $d = 0.21$, 95% CI = 0.14, 0.28; RE: $d = 0.23$, 95% CI = 0.12, 0.33), FE: $Q(1) = 28.47$, $p < .001$; RE: $Q(1) = 11.00$, $p < .001$, or when multiple choices were made from a single list of options (FE: $d = 0.18$, 95% CI = 0.04, 0.31; RE: $d = 0.25$, 95% CI = −0.02, 0.53), FE: $Q(1) = 17.72$, $p < .001$; RE: $Q(1) = 3.82$, $p < .05$. There was no difference between the average weighted effect of choice when participants made a single choice compared to when multiple choices from a single list of options were made, FE: $Q(1) = 0.15$, $p = .69$; RE: $Q(1) = 0.03$, $p = .85$.

Next, we broke down studies by the total number of choices given within a single choice manipulation. Several studies (Marinak, 2004; West, 1993; Thompson & Wankel, 1980) were excluded from this analysis because the actual number of choices given was either not reported or was unclear because the control group was also given some lesser amount of choice. The magnitude of the average weighted effect of choice on intrinsic motivation varied significantly with the total number of choices participants made under both models, FE: $Q(2) = 27.66$, $p < .001$; RE: $Q(2) = 10.28$, $p < .01$. Under fixed-effects assumptions, the average weighted effect of choice on intrinsic motivation when participants made two to four choices ($k = 12$; $d = 0.61$, 95% CI = 0.48, 0.75) was significantly greater than the average weighted effect of choice when participants made just one choice ($k = 21$; $d = 0.21$, 95% CI = 0.14, 0.28), $Q(1) = 27.46$, $p < .001$, or the effect when participants made five or more choices ($k = 12$; $d = 0.32$, 95% CI = 0.22, 0.43), $Q(1) = 11.36$, $p < .001$. There was no difference between the average weighted effect of choice when participants made just one choice compared to when participants made five or more choices, $Q(1) = 3.31$, $p < .07$. Under random-effects assumptions, the average weighted effect of choice on intrinsic motivation when participants made two to four choices ($d = 0.63$, 95% CI = 0.38, 0.88) was significantly greater than the effect when participants made just one choice ($d = 0.23$, 95% CI = 0.12, 0.33), $Q(1) = 8.43$, $p < .001$. However, the average weighted effect of choice when participants made two to four choices was not significantly different from the effect of choice when participants made five or more choices, $Q(1) = 1.21$, $p = .27$. Again, there was no difference between the average weighted effect of choice when participants made just one choice compared to when participants made five or more choices, $Q(1) = 3.31$, $p < .07$.

Reward. In a number of studies, a factorial design was used such that not only was choice manipulated, but the presence or absence of reward was also manipulated in a single study. In addition, a number of studies used a choice of reward as the choice manipulation, such that participants chose the reward they would receive at the end of the experimental phase. Consequently, we were able to look at the relationship between the presence of reward and the magnitude of the effect of choice on intrinsic motivation.

Grubbs's outlier test was conducted on the rewards moderator analysis effect size data set. No new outliers were detected. Two studies (Keefer, 1988; New, 1978) were excluded from this analysis because effect sizes were collapsed across reward and no-reward conditions in these studies. The average weighted effect of

[4] It should be noted that the more than five options group had 18 effects contributing to its average weighted effect, rather than the 17 effects that would be expected to result, because the more than five options ($k = 10$) and the large, indeterminate options ($k = 7$) groups were combined. This is because one study (Zuckerman et al., 1978) was excluded from the contrast that compared the more than five options and the large, indeterminate options groups because it fit into both categories. That is, in this study, participants were given multiple choices; for some, a specified number greater than five options was given, and for others, an indeterminate number of options was available. However, after collapsing across these groups, this study could be included in the overall moderator analysis for number of options.

choice significantly varied depending on whether participants received a reward internal to the choice manipulation ($k = 5$), a reward external to the choice manipulation ($k = 5$), or no reward ($k = 40$) under both models, FE: $Q(2) = 24.41$, $p < .001$; RE: $Q(2) = 12.16$, $p < .005$. An identical pattern emerged under fixed- and random-effects assumptions. The effect of choice was significantly smaller when rewards external to the choice manipulation were given (FE: $d = -0.01$, 95% CI $= -0.15$, 0.12; RE: $d = -0.02$, 95% CI $= -0.22$, 0.18) compared to when a reward internal to the choice manipulation was given (FE: $d = 0.35$, 95% CI = 0.16, 0.54; RE: $d = 0.36$, 95% CI = 0.08, 0.64), FE: $Q(1) = 9.35$, $p < .005$; RE: $Q(1) = 4.71$, $p < .05$, or when rewards were not implemented at all (FE: $d = 0.35$, 95% CI = 0.29, 0.41; RE: $d = 0.40$, 95% CI = 0.27, 0.52), FE: $Q(1) = 24.12$, $p < .001$; RE: $Q(1) = 11.89$, $p < .001$. However, there was no difference between the average weighted effect of choice when a reward internal to the choice manipulation was given compared to when rewards were not implemented, FE and RE: $Q(1) = 0.01$, $p = .94$.

Control group. First, we conducted outlier tests on the effect size data set used to examine whether the type of control group moderated the effect of choice on intrinsic motivation. Two outliers were identified ($d = 3.97$ and $d = 3.42$; Iyengar & Lepper, 1999) and Winsorized to their next nearest neighbor ($d = 2.74$). One sample (Courtney, 1984) used a control group in which participants were given a suggested choice, and two samples (Marinak, 2004; West, 1993) used a control group in which participants were given some degree of choice, although fewer choices than participants in the experimental condition were given. These samples were excluded from this control group moderator analysis because there was an insufficient number of samples that tested the effect of choice on intrinsic motivation in comparison to these two types of control groups.

Next, we assessed whether the nonsignificant-other choice control group ($k = 32$) and random-assignment control group ($k = 6$) were distinct. This was examined because in some studies it was not made explicit to the participants how they were being assigned an option (either randomly or by the experimenter). In these cases, although control participants were operationally assigned an option on the basis of one of the two methods, it was difficult to determine whether the participants' perceptions of how they were given an option were in line with the manipulation. Under both fixed- and random-error assumptions, the average weighted effect of choice on intrinsic motivation when a control group was chosen by a nonsignificant other (FE: $d = 0.30$, 95% CI = 0.23, 0.37; RE: $d = 0.45$, 95% CI = 0.30, 0.60) was not significantly different from the average weighted effect of choice when a control group was randomly assigned (FE: $d = 0.23$, 95% CI = 0.12, 0.35; RE: $d = 0.34$, 95% CI = 0.03, 0.66), FE: $Q(1) = 0.94$, $p = .33$; RE: $Q(1) = 0.36$, $p = .55$. Therefore, these control groups were collapsed and generically labeled a *no-choice control group*.

The average weighted effect of choice on intrinsic motivation significantly varied for different types of control groups under fixed-error assumptions, $Q(2) = 6.73$, $p < .05$, but not under random-error assumptions, $Q(2) = 0.12$, $p = .94$. Fixed-effects pairwise comparisons indicated that the average weighted effect of choice on control participants who were denied choice ($k = 8$; $d = 0.43$, 95% CI = 0.30, 0.57) was significantly greater than the effect of choice on participants who were assigned an option through either random assignment or a nonsignificant other's choice ($k = 38$; $d = 0.28$, 95% CI = 0.23, 0.34), $Q(1) = 4.06$, $p < .05$. The effect of choice on control participants who were given no choice through either random assignment or a nonsignificant other's choice was not significantly different from the average effect of choice when a significant other chose for control participants ($k = 7$; $d = 0.49$, 95% CI = 0.28, 0.70), $Q(1) = 3.40$, $p < .07$. Finally, there was no difference between the average effect of choice on control participants who were denied choice versus participants in a control condition in which a significant other chose for the participant, $Q(1) = 0.19$, $p = .66$.

Control group knowledge of alternatives. An outlier test was conducted on the control group knowledge of alternatives moderator analysis effect size data set. No new outliers were detected. One study (Cordova & Lepper, 1996) was excluded from this analysis because it was unclear whether control participants were aware of the alternative options among which they did not receive a choice.

Under a fixed-effects model, the average weighted effect of choice on intrinsic motivation was much greater when the choice condition participants were compared to control participants who were aware of alternatives among which they were not permitted to choose ($k = 26$; $d = 0.36$, 95% CI = 0.28, 0.44) versus when control participants were not aware of alternatives ($k = 26$; $d = 0.24$, 95% CI = 0.18, 0.31), $Q(1) = 4.89$, $p < .05$. However, there was no significant difference between the groups under a random-effects model, $Q(1) = 0.77$, $p = .38$.

Sample. First, we assessed whether the effect of choice was distinct for college students ($k = 29$) compared to general adults ($k = 4$). Under both fixed- and random-effects assumptions, there were no significant differences in average weighted effect of choice on intrinsic motivation between college students (FE: $d = 0.26$, 95% CI = 0.20, 0.32; RE: $d = 0.30$, 95% CI = 0.20, 0.41) and general adults (FE: $d = 0.19$, 95% CI = 0.01, 0.37; RE: $d = 0.36$, 95% CI = 0.01, 0.72), FE: $Q(1) = 0.49$, $p = .48$; RE: $Q(2) = 0.10$, $p = .75$. Therefore, these samples were collapsed. Next, we assessed whether the effect of choice varied between students of different ages. Under both fixed- and random-effects assumptions, there were no significant differences in average weighted effect of choice on intrinsic motivation between primary school students ($k = 10$; FE: $d = 0.51$, 95% CI = 0.37, 0.65; RE: $d = 0.52$, 95% CI = 0.20, 0.84), preschool children ($k = 2$; FE: $d = 0.41$, 95% CI $= -0.08$, 0.89; RE: $d = 0.43$, 95% CI $= -0.18$, 1.04), or middle school students ($k = 1$; FE: $d = 0.88$, 95% CI = 0.51, 1.25; RE: $d = 0.88$, 95% CI = 0.51, 1.25), FE: $Q(2) = 3.77$, $p = .15$; RE: $Q(2) = 2.60$, $p = .27$. Therefore, these student samples were also collapsed.

Under fixed-error assumptions, the weighted mean *d*-index was significantly higher for preschool to 12th grade students ($k = 13$; $d = 0.55$, 95% CI = 0.42, 0.67) than for adults ($k = 33$; $d = 0.25$, 95% CI = 0.20, 0.31), $Q(1) = 17.76$, $p < .001$. Under random-error assumptions, there was no difference in the effect of choice on intrinsic motivation for children compared to adults, $Q(1) = 2.72$, $p < .10$.

Measurement type. One study from Reeve et al. (2003) was excluded from the measurement type moderator analysis because the intrinsic motivation measure was a combined behavioral and self-report measure. There was no difference between the effect of choice on behavioral measures ($k = 22$; FE: $d = 0.29$, 95% CI = 0.20, 0.39; RE: $d = 0.39$, 95% CI = 0.22, 0.56) compared to the

effect on self-report measures of intrinsic motivation ($k = 32$; FE: $d = 0.31$, 95% CI = 0.24, 0.37; RE: $d = 0.36$, 95% CI = 0.25, 0.48), FE and RE: $Q(1) = 0.05$, $p = .82$.

Outcome. Several effects (from Abrahams, 1988; Becker, 1997; Dwyer, 1995; Landsteward, 1991; Reeve et al., 2003) were excluded from the intrinsic motivation outcome moderator analysis because they were either combined or nonspecific measures of intrinsic motivation. First, we assessed whether the two free-choice measures were distinct. Under both fixed- and random-effects models, the average weighted effect of choice on free-choice time spent measures ($k = 19$; FE: $d = 0.31$, 95% CI = 0.20, 0.42; RE: $d = 0.39$, 95% CI = 0.19, 0.59) was not significantly different from the average weighted effect of choice on free-choice decisions to engage in the activity or not ($k = 4$; FE: $d = 0.18$, 95% CI = −0.11, 0.47; RE: $d = 0.16$, 95% CI = −0.20, 0.52), FE and RE: $Q(1) = 0.65$, $p = .42$.[5] Therefore, these two free-choice measures were collapsed. However, the average weighted effect sizes between choice and intrinsic motivation measured by free-choice measures ($k = 21$), enjoyment or liking ($k = 16$), interest ($k = 14$), or willingness to engage in the task again ($k = 13$) were not significantly different from one another under either fixed-error assumptions, $Q(3) = 5.76$, $p = .12$, or random-error assumptions, $Q(3) = 3.73$, $p = .31$.

Study design. Study designs fell into three categories: yoked designs ($k = 21$), matched designs with reduced choice ($k = 10$), and designs in which no attempt at yoking or matching was made ($k = 12$). In yoked designs, the experimenter matched a control participant with an experimental participant so that in both conditions there were an equal number of participants doing the same task or that had the same task options (e.g., Iyengar & Lepper, 1999). In both yoked and matched designs the goal was to control for variation in intrinsic motivation attributable to which task or option the participants chose or were assigned. In matched designs, this was accomplished by excluding participants from the choice condition who did not engage in a target activity or option so that every participant in both choice and control conditions had the same task or option. However, in all cases in which a matched design was used, either choices were made nonequivalent or participants were subtly pressured to choose a particular option. In some studies, this reduced choice was intentionally created. For example, in one study (Swann & Pittman, 1977), children in the choice condition were given a choice between several games, whereas control condition children were assigned to a drawing task. To encourage children in the choice condition to choose the drawing task, experimenters stated that because the participants were sitting in front of the drawing game, they could just play that game, though the choice was totally theirs. In another study (Courtney, 1984), participants were given a choice between two task options. However, to prevent the excessive discarding of participants' data, one option was more desirable than the other. In other studies, nonequivalent options were unintentionally created. For example, in one study (Schraw et al., 1998), participants were given a choice between three seemingly equivalent texts. However, one text was chosen more often than the others, suggesting that it had actually been more desirable. Consequently, the authors limited analyses to participants who chose or were assigned to that text. What each of these scenarios has in common is that the sense of having a true choice was reduced through some mechanism. Hence, we referred to these designs as matching with reduced choice. Three studies (Cordova & Lepper, 1996; Detweiler et al., 1996; Prusak et al., 2004) were excluded from the study design moderator analysis because we were unable to determine whether a yoked or matched design was used or not.

The average weighted effect of choice significantly varied with the design under both fixed-effects and random-effects models, FE and RE: $Q(2) = 7.40$, $p < .05$. The effect of choice on intrinsic motivation when a yoked design was used (FE: $d = 0.37$, 95% CI = 0.28, 0.45; RE: $d = 0.51$, 95% CI = 0.34, 0.69) was significantly greater than the effect of choice when a matched design with reduced choice was used (FE: $d = 0.20$, 95% CI = 0.11, 0.30; RE: $d = 0.20$, 95% CI = 0.03, 0.37), FE: $Q(1) = 6.32$, $p < .01$; RE: $Q(1) = 6.16$, $p < .01$, or when no attempt was made to match or yoke (FE: $d = 0.23$, 95% CI = 0.13, 0.33; RE: $d = 0.24$, 95% CI = 0.11, 0.38), FE and RE: $Q(1) = 3.95$, $p < .05$. However, there was no difference between the average weighted effect of choice when no attempt was made to match or yoke compared to the average weighted effect of choice when a matched design was used, FE: $Q(1) = 0.17$, $p = .68$; RE: $Q(1) = 0.11$, $p = .74$.

Setting. The settings of the experiment fell into three categories: the university laboratory ($k = 29$); a natural environment ($k = 5$), such as a school, workplace, or fitness center; or a lab within a natural setting ($k = 11$). Examples of studies conducted in a laboratory within a natural setting are those in which participants were run through the experiment individually in a separate classroom of the school that they attended (e.g., D'Ailly, 2004; Iyengar & Lepper, 1999). Another example is one study in which the setting of the study was a fitness center, but participants were taken to a separate workout room and run through the experiment individually (e.g., Dwyer, 1995). In contrast, for experiments conducted in a natural setting, the experiment was inserted into the regular day-to-day activities of the classroom, fitness class, or workplace. For one study (Detweiler et al., 1996), the setting in which the study was conducted was unclear. Consequently, this study was excluded for the setting moderator analysis.

The average weighted effect of choice on intrinsic motivation varied significantly for different settings under fixed-error assumptions, $Q(2) = 13.19$, $p < .001$, but not under random-error assumptions, $Q(2) = 3.43$, $p = .18$. Fixed-error pairwise comparisons indicated that the average weighted effect of choice for studies conducted in laboratories within natural settings ($d = 0.55$, 95% CI = 0.41, 0.69) was significantly greater than the average effect of choice in traditional university lab settings ($d = 0.26$, 95% CI = 0.20, 0.32), $Q(1) = 13.11$, $p < .001$, and the effect of choice within natural settings ($d = 0.33$, 95% CI = 0.17, 0.49), $Q(1) = 4.06$, $p < .05$. However, the average effect of choice in

[5] The final k for free-choice measures of intrinsic motivation was 21, as can be seen in Table 5. Although there were 19 measures of how free-choice time was spent and 4 measures of free-choice decisions to engage in an activity or not, two studies produced an effect size for each type of free-choice measure. Consequently, the final k was 21, rather than 23, once we collapsed across all free-choice measures.

a traditional university lab was not significantly different from the effect of choice in a natural setting, $Q(1) = 0.54$, $p = .46$.

Relations Between Moderator Variables

The moderator analyses revealed a number of significant predictors of the relationship between choice and intrinsic motivation. Because each moderator was tested individually, the possibility exists that moderators are confounded with one another (see Cooper, 1998, for a discussion of study-generated and synthesis-generated evidence). For example, although both the age of participants and the setting of the study were found to be significant predictors of the effect of choice on intrinsic motivation, it is possible that children may have been more likely to be tested in a natural setting, whereas adults may have been more likely to be tested within a traditional university laboratory. Therefore, we examined the pairwise relationship between the significant moderator variables: choice type, number of choices, reward, sample, setting, control group, control group knowledge of alternatives, and study design. Though publication type was a significant moderator of the effect of choice, it was not included in these analyses because it was considered to be a proxy for more meaningful methodological and theoretical variations that would be captured in other moderator variables. A chi-square test was conducted when both variables in the pair were categorical in nature, and an analysis of variance was conducted when one variable in the pair was continuous. There were no tests conducted in which both moderator variables were continuous. The effect size was used as the unit of analysis. Effect sizes that were identical along all moderator categories were collapsed prior to analysis such that each effect size varied on at least one moderator category from every other effect size within a study. The results of all tests are reported in Table 6.

Analyses revealed two clusters of confounded variables using a conservative p value of .01. First, it is clear that study design (whether or not control participants were yoked or matched with reduced choice) was significantly confounded with choice type, the total number of choices made, and the presence of reward. One way to describe this cluster of confounded study variations would be as follows: Compared to other designs, yoked designs were more likely to use instructionally irrelevant choices and to have more choices. In contrast, matched designs with reduced choice were more likely to use a choice of activities and to manipulate the presence of external reward. Second, the sample, setting, type of control group, and knowledge of alternatives appear to be confounded elements in the design of choice experiments. One way to describe this cluster of confounded study variations would be as follows: Compared to studies using adult samples, studies using child samples were more likely to be conducted in a lab within a natural setting, more likely to compare the effect of choice to that of a control group in which a significant other was allowed to choose, and more likely to implement a control group in which participants knew that alternatives existed to the option they were assigned. Studies conducted with an adult sample were more likely to be tested in a traditional lab setting and more likely to have a control group in which participants were unaware of alternative

Table 6
Relations Between Moderator Variables

Moderator variable	Choice type	Reward	Sample	Setting	Control group	Knowledge of alternatives	Study design
Reward	$\chi^2(8, N = 89) = 105.84$ $p < .0001$						
Sample	$\chi^2(4, N = 91) = 11.22$ $p < .03$	$\chi^2(2, N = 100) = 2.03$ $p < .37$					
Setting	$\chi^2(8, N = 90) = 18.78$ $p < .03$	$\chi^2(4, N = 99) = 4.32$ $p < .37$	$\chi^2(2, N = 106) = 76.41$ $p < .0001$				
Control group	$\chi^2(8, N = 88) = 13.91$ $p < .09$	$\chi^2(4, N = 96) = 3.89$ $p < .42$	$\chi^2(2, N = 102) = 20.22$ $p < .0001$	$\chi^2(4, N = 101) = 24.98$ $p < .0001$			
Knowledge of alternatives	$\chi^2(4, N = 89) = 6.65$ $p < .16$	$\chi^2(2, N = 98) = 3.80$ $p < .15$	$\chi^2(1, N = 105) = 9.68$ $p < .005$	$\chi^2(2, N = 104) = 17.01$ $p < .0005$	$\chi^2, N = 100) = 34.71$ $p < .0001$		
Study design	$\chi^2(8, N = 89) = 77.77$ $p < .0001$	$\chi^2(4, N = 97) = 24.48$ $p < .0001$	$\chi^2(2, N = 104) = 6.96$ $p < .04$	$\chi^2(4, N = 103) = 21.61$ $p < .005$	$\chi^2(4, N = 99) = 11.43$ $p < .03$	$\chi^2(2, N = 104) = 3.94$ $p < .14$	
Total choices	$F(4, 83) = 29.45$ $p < .0001$ $N = 88$	$F(2, 93) = 2.39$ $p < .10$ $N = 96$	$F(1, 101) = 0.04$ $p < .85$ $N = 103$	$F(2, 99) = 1.08$ $p < .35$ $N = 102$	$F(2, 98) = 0.34$ $p < .72$ $N = 101$	$F(1, 99) = 0.22$ $p < .64$ $N = 101$	$F(2, 97) = 17.70$ $p < .0001$ $N = 100$

options. Most of the significant interrelations in Table 6 can be explained by these two clusters.[6]

Discussion

The results of this meta-analysis suggest that choice can have a positive overall effect on intrinsic motivation, as well as on a number of related outcomes including effort, task performance, perceived competence, and preference for challenge. Results for measures of creativity and satisfaction were in the predicted direction but not statistically significant. The degree to which participants felt pressure or tension appeared unaffected by the choice manipulation. Choice was found to have a positive effect on subsequent learning, but the effect was small and not statistically different from zero. However, the experimental studies included in this meta-analysis were generally brief in duration, being conducted in a single session or, at most, a few sessions across several weeks. Thus, these designs can examine only the most short-term effects of choice. It seems reasonable then to expect that if more frequent choices were provided over a more extended period of time, significant long-term effects on subsequent learning would result. Future research should examine the effects of choice on subsequent learning under more sustained circumstances that have potential for greater impact.

It is also important to note that some of these findings were based on small numbers of effect sizes, so it is difficult to place a great deal of confidence in the specific magnitude of the estimated effects. Further, the inclusion criterion of requiring that all studies have a measure of intrinsic motivation necessarily excluded studies that tested only the effect of choice on performance, learning, effort, and other relevant outcomes but not the effect of choice on intrinsic motivation. Therefore, it is possible that if the entire literature on the effects of choice on relevant outcomes other than intrinsic motivation were collected, different results might emerge. This may be a particularly important caution with regard to the finding that the effect of choice on learning did not reach statistical significance. That is, a number of studies that did not meet the selection criteria for this meta-analysis address the question of choice, performance, and learning. For example, a number of methodologically similar studies have suggested that when participants were given a choice of words to be used in a paired-associates learning task, they demonstrated greater immediate performance and may have learned more and faster across multiple trials (e.g., Monty, Rosenberger, & Perlmuter, 1973; Perlmuter & Monty, 1973; Perlmuter, Monty, & Kimble, 1971). Research coming out of the computerized testing theory literature has suggested that students performed better on self-adapted tests (those in which the student selects test items from among options) than on computer-adapted versions (those in which the computer selects test items; e.g., Rocklin & O'Donnell, 1987; Rocklin, O'Donnell, & Holst, 1995). Still, other research has shown no effect of choice on learning. For example, one study found that students performed more poorly on a posttest when the learner controlled the computer-based instruction compared to when the program controlled the instruction (Pollock & Sullivan, 1990). Similarly, students performed more poorly on posttest achievement under learner-controlled instructional support conditions compared to other conditions (Morrison, Ross, & Baldwin, 1992). Although it is possible that inclusion of the entire body of studies testing the effect of choice on learning would have led to finding a significant effect, a cursory look at the broader literature suggests that findings have been somewhat inconsistent.

Theoretically driven moderator analyses revealed that choice appeared to be most effective when instructionally irrelevant choices were given compared to other types of choices, when the participant made two to four and successive choices (not less or more), and when a reward external to the choice manipulation was not involved. The effect of choice also appeared most influential when (a) control participants were explicitly denied choice or (b) when control participants were aware of the choice alternatives but were not allowed to choose. In addition, the effect of choice was greatest when yoked designs were used compared to matched designs in which choice was reduced (by persuasion or differentially attractive alternatives) or designs in which no attempts were made to control for the task (nonyoked, nonmatched designs).

Exploratory analyses revealed that choice was more effective for children compared to adults and when manipulations were implemented within a "controlled" natural setting, in particular, when a laboratory environment was created within a natural setting, such as a school or workplace. Contrary to a previous meta-analysis examining the self-determination perspective (Deci et al., 1999), there was no difference in the effect of choice between behavioral and self-report measures of intrinsic motivation. Further, the effect of choice did not vary depending on the measure of motivation.

Fit of Data to Theoretical Predictions

Type of choice. In line with self-determination theory, all types of choice had a significant positive effect on intrinsic motivation. Self-determination theory also predicts that choices that are meaningful (Williams, 1998) and that allow individuals to control the actions they take within a task (Reeve et al., 2003) may provide the greatest opportunity for the individual to gain a sense of autonomy and therefore enhance intrinsic motivation and related outcomes. According to this framework, it would be predicted that instructionally relevant choices would have the greatest positive effect on motivation because they are the most meaningful and present the greatest opportunity to control the actions taken within a task. In contrast, a self-regulatory strength model would predict that choice would have a negative impact to the extent that choice is an effortful process. Therefore, choices that are highly meaningful, either personally or instructionally, may be more effortful to the extent that they tap into an individual's values, goals, and interests. Thus, the choice made may have consequences that are more important to the individual. When faced with a choice that

[6] An alternative strategy would have been to conduct a meta-regression in which multiple moderator variables would be included in a single regression equation. This approach would have controlled for all other moderator variables while examining the impact of each individual moderator on the magnitude of the effect. However, we expected and found that moderator variables were confounded in complex ways, not an unusual circumstance for meta-analytic data. Effect sizes cluster together among certain moderator variable categories, and it would be nearly impossible to disentangle their effects. Therefore, we thought it prudent to simply demonstrate the revealed confounds and to use this information to provide caution in interpretation.

has personal or instructional consequences, it may be more difficult to make a decision, particularly when the choices are equally desirable. In contrast, when a choice is fairly superficial and is of little personal or instructional significance, such as choosing what color paper to write on or what pen to write with, it may be easy to make a choice because the implications are minimal, no matter what option is chosen. Consequently, according to a self-regulatory strength perspective, it may be these "easy" choices that will result in the least ego-depletion and allow for more positive effects of being given a choice.

Results from this meta-analysis suggest that instructionally irrelevant choices had the greatest impact on intrinsic motivation. This finding may best be viewed as a compromise between the theories. That is, although all types of choices provide benefit in the form of the opportunity for an individual to obtain a sense of autonomy and competence that supports intrinsic motivation, there is still a self-regulatory implication of making a choice that may diminish the positive effect. The more positive effect on intrinsic motivation of instructionally irrelevant choices may be explained, according to the self-regulatory perspective, by its being the least effortful form of choice making.

Several alternative explanations for the stronger effect of instructionally irrelevant choices should also be considered. First, it is possible that participants construe what we have termed *instructionally irrelevant choices* as meaningful ways to express their personal identities. That is, although these instructionally irrelevant choices had little consequence for what or how individuals learned while engaging in a task, allowing participants to, for example, choose what color pen to use, what name to give a game character, or what music to listen to while exercising, may be a powerful motivator to the extent that these choices facilitate the expression of individuality. Alternatively, the stronger effect of instructionally irrelevant choices may be driven by the control group. That is, those who are assigned an option for an instructionally irrelevant aspect of a task may experience a greater decrement in motivation compared to control groups that were assigned an activity, version, reward, or instructionally relevant aspect of the task. A tenet of self-determination theory suggests that providing individuals with a rationale for a task they are asked to engage in or the options imposed on them prevents undermining effects and may even support feelings of autonomy and intrinsic motivation (Deci, Eghrari, Patrick, & Leone, 1994; Koestner, Ryan, Bernieri, & Holt, 1984). Therefore, when participants in the control group are assigned options for instructionally irrelevant aspects of a task, they may perceive little rationale for having an option imposed on them. In contrast, when participants are assigned a specific activity, version of an activity, reward, or in particular, an instructionally relevant aspect of the task, as discussed before, the option participants settle on may have greater consequences for learning, and therefore, participants may be more likely to believe that there is good reason for why they were assigned the option. Future research should examine the differential effect of various forms of choice within the same study, make attempts to assess the relative effort exerted in terms of self-control for each type of choice, and explore how participants construe each type of choice.

Number of choices. One of the most robust findings in the meta-analysis was that the total number of choices moderated the effect of choice on intrinsic motivation. Choice had the greatest effect when participants chose a single option from a list of options and did so repeatedly, as opposed to making just a single choice or multiple choices from a single list of options. Similarly, the largest positive effect of choice on intrinsic motivation was found when participants made two to four choices in a single experimental manipulation compared to when only a single choice or five or more choices were made. It should also be noted that analyses testing the moderating role of number of options on the effect of choice revealed a similar pattern that approached statistical significance. Specifically, choice had the greatest effect when participants were provided with three to five options among which to choose compared to when provided with only two options or more than five options. Again, these results were generally in line with the hypotheses and support the notion that self-determination theory and a self-regulatory strength model can be successfully integrated to improve predictions regarding choice's effects on motivation. Whereas a self-determination model might predict that too few choices (or options) may not be powerful enough to bolster an individual's sense of autonomy, the self-regulatory strength model would suggest that more choices means more effort and energy exerted. That is, making just a single choice (or being given just two options) does not have the same impact on autonomy and intrinsic motivation compared to when participants are given the opportunity to make multiple successive choices. However, the cognitive workload of making choices increases with the number of choices (or options). Consistent with this notion, the meta-analysis revealed there was a diminishing return for the effect of choice on intrinsic motivation after five or more choices have been made.

Although past research has examined the effect of the number of options provided on the effectiveness of choice, no study to date has examined whether making a greater number of choices within a single manipulation influences the effectiveness of choice. It is important that future research experimentally examine the moderating influences on the total number of choices and whether making a greater number of choices within a limited time frame actually requires an individual to exert more self-control compared to when fewer choices are made.

External rewards. Central to self-determination theory is the prediction that external rewards undermine intrinsic motivation, particularly for tasks that an individual finds interesting, because rewards are interpreted by recipients as controllers of their behavior (Deci et al., 1999). Consequently, self-determination theory would predict that the positive effect of choice might be diminished when rewards were given compared to when rewards were not involved. As predicted, these two countervailing influences on intrinsic motivation worked in opposition. Specifically, the effect of choice was essentially zero when a reward external to the choice manipulation was provided compared to when participants chose the reward they would receive or when no reward was involved. The finding that the effect of choice is diminished when unrelated rewards are provided appears to be consistent with self-determination theory. Providing rewards in this fashion seems to communicate to individuals that they are being controlled. However, more nuanced is the finding that as long as individuals choose the reward, the reward has no impact on the effectiveness of having been given choice. This finding suggests that as long as individuals have some control over the reward, it is not perceived as controlling, and the positive effect of choice on motivation

remains. Finally, it should be noted that although self-determination theory predicts different effects for different types of rewards (Deci et al., 1999), the small number of studies examining the effect of choice under each type of reward condition prevented us from breaking down this moderator analysis further. Further, results of this synthesis and others have suggested that there are age differences in the effect of choice and rewards (Deci et al., 1999). Consequently, it is possible that the joint effect of reward and provision of choice may change with age. Future research should examine these interactive effects.

Control conditions. Finally, self-determination theory, as well as reactance theory, suggests that the absence or removal of choice may be detrimental to motivation. Specifically, self-determination theory predicts that conditions that are experienced as controlling will diminish intrinsic motivation. Reactance theory suggests that motivation may be diminished when the elimination of people's ability to choose causes them to evaluate the alternatives they were not allowed to choose more positively and the remaining alternatives more negatively. In line with these predictions, this meta-analysis found that the provision of choice had the greatest effect on intrinsic motivation in comparison to a no-choice control condition that should have been experienced as the most controlling. Operationally, this included control conditions in which participants were denied a choice. Under this condition, participants likely experienced a decrement in intrinsic motivation. Consequently, the difference in intrinsic motivation between the choice condition and this more controlling no-choice condition was greater than the difference between the choice condition and no-choice conditions in which participants were randomly assigned an option or were assigned an option by an individual who was not significant to the participant in any way, such as the experimenter. Similarly, the effect of choice on intrinsic motivation was greatest in control conditions in which participants were aware that there were alternatives that they were not permitted to choose versus control conditions in which participants were not aware of alternatives. In light of both results, it is clear that when it is made explicit that an individual is not being given the opportunity to choose, this event is experienced as more controlling, resulting in reduced intrinsic motivation to engage in the task. Further, this raises the theoretically interesting question of whether or not having a choice actually diminishes intrinsic motivation as long as the lack of choice is not made salient. That is, although having a choice may always be better than having no choice of any nature, a lack of choice may be neutral in its effect if it is not made salient to the participant. Rather, it is only when a lack of choice is made salient to the participant that motivation is actually diminished. Future research could address this issue by examining baseline levels of intrinsic motivation in order to see under what conditions having no choice diminishes motivation for that task. Through a baseline measure it could be determined whether participants experience a decrease, increase, or no change in intrinsic motivation in various no-choice conditions.

Nevertheless, it needs to be noted that these two aspects of the control condition were necessarily confounded with one another. That is, all control participants who were denied a choice were necessarily aware of alternative options existing, whereas other control conditions varied in this respect. Likewise, both aspects were confounded with the age of the sample, the setting of the experimental manipulation, and the study design, and knowledge of alternatives was confounded with the number of options provided. Consequently, the possibility remains that the moderating role of either the type of control group or control group knowledge of alternatives is reducible to just one of these moderating variables or an additional unmeasured variable.

Reduced choice and study design. We examined whether the effect of choice was moderated by the use of yoking versus matching participants. We found that the effect of choice was greatest when a yoked design was used compared to when a matched design with reduced choice or a nonyoked, nonmatched study design was implemented. In part, this pattern was in line with our theoretical predictions. Specifically, it was clear that the matched designs also implemented tactics meant to facilitate the matching process. However, these tactics, such as subtly pressuring the participant to choose a particular option or providing options dissimilar in attractiveness, had the undesirable effect of reducing the sense of having a true choice and may actually have enhanced feelings of being controlled.[7] In line with self-determination theory, the designs with reduced choice had the smallest effect of choice on intrinsic motivation. On the one hand, with regard to the finding that yoked designs were associated with enhanced choice effects compared to nonyoked, nonmatched studies, we might have expected that the effect of choice would be reduced in yoked designs compared to nonyoked, nonmatched designs because yoking controls for a number of potentially confounded variables associated with the nature of the task. That is, in a yoked design every choice participant has a corresponding control participant that received the same task or options. Consequently, the effect of choice cannot be attributed to the possibility that some tasks or options were more naturally motivating than others and that choice participants had the opportunity to choose those tasks or options. On the other hand, it may be that yoking is a sophisticated and effective design element that requires careful planning. Therefore, researchers who implemented yoking may also have been more likely to use other successful methods in order to maximize the effectiveness of the choice manipulation.

Exploratory Analyses

Age effects. This meta-analysis suggests that choice had a greater effect on intrinsic motivation for children than for adults. Although self-determination theory makes no predictions regarding the moderating effects of age, previous meta-analyses examining other aspects of self-determination theory have found differences between children and adults as well. Specifically, Deci et al. (1999) found that tangible rewards are more detrimental to intrinsic motivation for children than for college students. An understanding of the behavioral concept of establishing operations

[7] It should be noted that the choice condition in matched designs is very similar to the control condition we have labeled *suggested choice*. One study (Courtney, 1984) had a suggested choice control condition in which participants were given a choice but were pressured to pick a particular option in light of various reasons or incentives. However, this study was also a matched study design with a reduced choice condition in which options were made dissimilar in order to encourage choice participants to pick a particular option. Another study (West, 1993) had multiple control conditions, one of which was a suggested choice control, which were collapsed across in primary analyses.

(Keller & Schoenfeld, 1950; Michael, 1993) may provide some insight into why children experience choice as more motivating than do adults. Keller and Schoenfeld (1950) first used the term *establishing operation* to refer to any environmental condition or process that establishes a drive through deprivation or stimulation (p. 274). To the extent that an organism is deprived in some fashion, a reinforcer that relieves that deprivation will be more powerful. For example, food deprivation increases the reinforcing effect of food and evokes behaviors that have a history of leading to food (Michael, 1993). In line with this notion, it may be that children experience fewer opportunities to make choices and to enhance their senses of autonomy than do adults. Consequently, when a child encounters an opportunity to make choices and experience a sense of autonomy, the effect is more powerful.

Setting. We found that the effect of choice varied as a function of setting. Specifically, choice had the greatest effect on intrinsic motivation when the choice manipulation was implemented in a laboratory context embedded within a natural setting, for example, when students were taken to a separate room within the school they attended or employees were taken to a separate room within their workplace. One explanation for this finding may be that the choices given within these "mixed" settings may be experienced as more authentic and, therefore, may have greater impact in comparison to the impact of those given in a traditional laboratory setting within a university. However, a laboratory context within a natural setting may also afford the experimenter greater ability to control any confounding factors, compared to a natural setting in which the experimenter includes choice manipulation in the routine of the classroom or workplace, therefore strengthening the manipulation.

Limitations to Generalizability

First, as noted, an important limitation of the conclusions that can be drawn from this meta-analysis (indeed any meta-analysis) is that there were several clusters of moderator variables that were confounded with one another. Specifically, it remains difficult to tease apart the moderating effects of study design, choice type, reward, and number of choices, because the most effective design (yoked design) was confounded with the most effective choice type (irrelevant choice) and with a greater number of choices being given. Likewise, it remains difficult to tease apart the moderating effects of sample, setting, and control conditions. For example, sample and setting were confounded such that studies using child samples were more likely to be conducted in a lab within a natural setting, and studies using adult samples were more likely to be conducted in a traditional lab setting. The interrelationships between moderator variables make it difficult to determine which moderators have a causal relationship with the effect of choice on intrinsic motivation and which may have been spurious. Given the limitations of this (and any) meta-analysis to isolate the effect of individual moderators, future research should take measures to tease apart the individual effects of each of these variables.

The confounding issue reminds us that in all meta-analyses it is also important to keep in mind that synthesis-generated evidence should not be interpreted as supporting statements about causality (see Cooper, 1998). When groups of effect sizes are compared within a research synthesis, even when they come from experiments using random assignment, the synthesis can establish an association only between a moderator variable and the outcomes of the studies, not a causal connection. Thus, when different study characteristics are found to be associated with the effect sizes, these findings should be used to direct future researchers to examine these factors using a more controlled design so that the causal impact of the factors can be appraised.

Finally, there were a number of potentially interesting and theoretically relevant variables that could not be examined as moderators of the effect of choice. Ethnicity is one variable that has been found in previous research to moderate the effect of choice on intrinsic motivation, performance, as well as a number of related outcomes (Iyengar & Lepper, 1999). That is, both Caucasian American and Asian American students who were given a personal choice demonstrated enhanced motivation and performance compared to when an experimenter chose for them. However, Asian American students demonstrated the greatest motivation and performance when a close significant other or peer made the choice for them compared to when they made a personal choice or when the experimenter chose for them. However, lack of reporting and lack of variability on this moderator prevented us from testing for the effect of ethnicity within this meta-analysis. Similarly, the limited number of international studies precluded the inclusion of international samples, making it difficult to determine if the effect of choice would hold across countries and cultures. Finally, a limited number of studies examined the effect of choice separately for males compared to females. Although a cursory look at a moderator analysis by gender suggested that the effect of choice may be stronger for females compared to males, this analysis was based on a small number of studies and should be interpreted with caution. Clearly, future research should investigate whether gender moderates the effect of choice and why, if gender is indeed found to be an important moderating variable.

Implications for the Use of Choice in the Real World

In the real world, people are faced with many choices every day. Further, choice is often used in classroom and workplace settings in order to enhance motivation, performance, and learning-related outcomes. For example, a phenomenological study of teachers' beliefs about instructional choice by Flowerday and Schraw (2000) suggested that providing choice is a popular method by which teachers attempt to enhance student motivation. Teachers reported believing that providing teacher-determined options to students increased student interest, engagement, and learning by increasing personal responsibility and motivation to learn.

Despite these beliefs commonly held by practitioners, little guidance has been available as to how choices may be implemented for the greatest benefit. The results of this meta-analysis may provide some advice. First, it may be important that a choice not be a laborious decision. Although it is important that individuals feel that they are autonomous and have authentic choice, choices that are highly effortful, perhaps due to the importance or consequences they carry, may diminish the positive effect of choice on motivation. Similarly, more choices, and possibly more options, may be better than fewer, but only up to a point. Allowing individuals to make multiple choices appears to yield greater benefits than does making a single choice. However, after a certain point, too many choices may become overwhelming and exhausting. Also, when the opportunity for choice is not possible, it

appears important that participants not focus on the controlling aspects of the environment; those who are most aware of not having received a choice show the greatest differences with their choosing counterparts. Likewise, when the choice itself is presented in a manner that includes pressure to pick a particular alternative or when the options are dissimilar in attractiveness, providing choice may have less benefit. Finally, the positive effect of choice on motivation may be diminished, indeed reduced to zero, when rewards external to the choice are also provided.

Conclusion

In a situation where we can allow or encourage people to choose, what should we do? The conclusion that can be drawn from this meta-analysis supports the assertion that when individuals are allowed to affirm their sense of autonomy through choice they experience enhanced motivation, persistence, performance, and production. However, the pattern of results also suggests that there are circumstances under which the positive effects of choice are diminished, in particular, when the self-regulatory costs of making choices become greater and when the experience of autonomy is undermined. This has numerous and profound implications for the healthful functioning of individuals, as well as for interpersonal relationships. Decisions that involve promoting autonomy or directing action in the workplace and classroom, therapy, intimate relations, and familial interactions have crucial implications for the effectiveness and viability of the individual and interpersonal situations. Choice is to be valued for the significant role it plays in facilitating human self-actualization. Still, as is true with so many areas of human activity, too much of a good thing may not be very good at all.

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