

Medium Maximization

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A medium—for example, points or money—is a token people receive as the immediate reward of their effort. It has no value in and of itself, but it can be traded for a desired outcome. Experiments demonstrate that, when people are faced with options entailing different outcomes, the presence of a medium can alter what option they choose. This effect occurs because the medium presents an illusion of advantage to an otherwise not so advantageous option, an illusion of certainty to an otherwise uncertain option, or an illusion of linearity to an otherwise concave effort-outcome return relationship. This work has implications for how points influence consumer choice and how money influences human behavior.

Wealth is evidently not the good we are seeking; it is merely useful and for the sake of something else. (ARISTOTLE, *Nicomachean Ethics*)

In order to achieve a desired outcome, we usually have to exert effort. Often, however, the immediate payoff of our effort is not the outcome we actually care about. Instead, it is merely an instrument, a token, which has no value in itself but can be traded for the outcome we care about. In other words, it is merely a “medium” between our effort and the desired outcome, as in the following:

Effort → medium → outcome.

Media are present in many decision contexts. For example, when a frequent-flyer-program member flies, he accumulates miles. Miles, however, are not what he really cares about. They are merely a medium that he can trade for free travel (a desired outcome) later on. When a loyalty-program member purchases a product, she may earn points, but the

points are not what she really wants. They are just a medium that she can redeem for a gift (a desired outcome) later on (see, e.g., Kivetz and Simonson 2002; Van Osselaer, Alba, and Manchanda 2001). When children in schools that adopt a token economy complete a task, they may receive chips (Kazdin 1982), but the chips are not what the children really want. They are just a medium that the children can trade for a piece of candy or some other desired good later on. More importantly, the money we earn from work is also a medium. Thus, the potential implication of research on medium is not medium; it is extra large.

Since the medium is inherently worthless, people should skip it and base their decision solely on the effort → outcome relationship. However, the effort → outcome relationship is typically not directly given, and one has to infer it from the two typically given relationships: the relationship between effort and the immediate payoff in medium (effort → medium) and the exchange relationship between medium and outcome (medium → outcome). In order to effectively skip the medium, one has to pay equal attention to these two types of relationships.

Our tenet is that people often fail to fully skip the medium and they maximize not just the effort → outcome return but also the effort → medium return. We refer to the pursuit of the effort → medium return as *medium maximization*. For example, suppose that a person could choose either a less-effortful action that gives her level of medium M_1 , which corresponds to outcome O_1 , or a more effortful action that gives her level of medium M_2 , which corresponds to outcome O_2 . Her decision of which action to take will be influenced not only by how much O_2 is better than O_1 but also by how much M_2 is greater than M_1 . In other words, if M_2 is sufficiently greater than M_1 , then, even if O_2 is no

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better than O_1 , she may still choose the more effortful action yielding M_2 and O_2 .

The remainder of the article is organized as follows. We first review the relevant literature and then define what we refer to as a medium effect. The main body of the article focuses on three specific types of medium effect and presents empirical findings for each type. We conclude with a discussion of theoretical and applied implications.

RELEVANT LITERATURE

A medium is similar to what learning theorists refer to as a conditioned reinforcer. Vast literature on learning suggests that a neutral stimulus can acquire a reinforcement value through association with a primary reinforcer and can change behaviors even after the primary reinforcer is removed (e.g., Armus 1982; Boysen et al. 1996; Bugelski 1938; Herrnstein 1964; Mazur 1995; Williams and Dunn 1991). A medium, such as points, may have acquired its reinforcement value via the extensive learning history extending back to one's childhood. For example, more points on a child's exam are usually followed by more praise from parents. As a consequence, points may have acquired a positive value and remain attractive even when the primary reinforcers (e.g., praise from parents) are no longer present.

Our medium maximization idea is also inspired by prior research suggesting psychological myopia. Psychological myopia here refers to a tendency in decision makers to focus on information immediately related to their choice or judgment and to ignore other (e.g., background) information. A prototypical example is money illusion, a phenomenon that has intrigued economists and psychologists alike for many years (Fisher 1928; Kahneman, Knetsch, and Thaler 1986; see also Fehr and Tyran 2001; Shafir, Diamond, and Tversky 1997). Money illusion is the finding that, in times of inflation, people overlook inflation rate information and base their judgment of a financial outcome on its nominal value rather than on its inflation-adjusted real value. For example, people find a 10% salary increase in times of a 12% inflation more satisfying than a 1% salary deduction in times of no inflation, even though the latter is better in real monetary terms. The money illusion reflects respondents' tendency to focus on the face value of the event to be judged and to ignore the background exchange relationship between the face value and the real outcome.

The same myopia seems to underlie medium maximization. As we discussed earlier, in decisions involving a medium, the two pieces of information decision makers typically have are (a) the effort \rightarrow medium relationship and (b) the medium \rightarrow outcome relationship. The former is about the immediate reward of their choice, and the latter is about the exchange rate between medium and outcome (very much like the exchange rate between nominal value and real value in money illusion). In order to effectively cancel the influence of a medium, decision makers should give equal considerations to the two relationships. But psychological myopia implies that decision makers will be sensitive to the effort \rightarrow medium relationship but relatively insensitive to

the medium \rightarrow outcome relationship. As a result, they will fail to fully cancel the influence of the medium.

Psychological myopia is a ubiquitous phenomenon and is implied in many other, seemingly unrelated, studies. One example is the research on proxy attributes versus fundamental attributes (e.g., Keeney 1980; 1994; Keeney and Raiffa 1976). A proxy attribute is an indirect, and often more available, index of a more fundamental attribute—a factor with which the decision maker is more concerned. For example, the concentration of pollutants in the air is a proxy attribute for a more fundamental attribute—the health consequence of pollution to humans. Keeney and Raiffa (1976) argued that the use of proxy attributes may lead to systematic biases and recommended that decision analysts use fundamental attributes instead. Subsequent research by Fischer et al. (1987) found that decision makers who were presented with proxy attributes did not spontaneously translate them into fundamental attributes and gave the proxy attributes more weight than warranted by expected utility theories. Consistent with medium maximization, this finding reflects the tendency to focus on the immediate outcomes and overlook the more fundamental outcomes.

Another study showing insensitivity to fundamental outcomes is from the ultimatum games literature. Kagel, Kim, and Moser (1996) found that, when players bargained over chips with different exchange rates, their perception of fairness was more focused on the distribution of the chips than the distribution of the final outcomes.

In their work on loyalty programs, Van Osselaer et al. (2001) have documented myopic maximization of intrinsically worthless points. In one of their simulated airline choice studies, the authors asked research participants to imagine that they could receive a free ticket if they had earned a certain number of points from an airline and to choose among several airlines that awarded points in different temporal sequences. The respondents tended to choose the airline that awarded the most points at the time of their choice, even though doing this was normatively suboptimal.

Another example of psychological myopia is the pseudo-certainty effect. Kahneman and Tversky (1984) found that most respondents preferred a 20% chance at \$45 over a 25% chance at \$30, but when the same problem was framed in terms of a two-phase problem where one had a 25% chance to pass the first phase and, if one passes the first phase, one can choose between an 80% chance at \$45 or a 100% chance at \$30, most people choose the latter. This result reflects two psychological processes. First, certainty (100%) has a particularly strong appeal. Second, and more pertinent to the present work, respondents in the contingent-probability condition based their decision myopically on the probabilities directly associated with the choice options (80% vs. 100%) and overlooked the background probability of 25%. Another example of psychological myopia in the context of a two-phase problem is the recent work by Sood, Rottenstreich, and Brenner (forthcoming) on decisions leading to other decisions. For example, when consumers who are

shopping for a camera are asked at which camera store they would buy the camera, instead of being directly asked which camera they would buy, the consumers show high sensitivity to the characteristics of the stores (e.g., number of options available) and low sensitivity to the qualities of the available cameras, which are the actual outcomes.

Another form of psychological myopia is identified in a set of recent studies by Leclerc, Hsee, and Nunes (2003). The studies show that consumers tend to favor a high-ranking product in a low-ranking category over a low-ranking product in a high-ranking category, holding the actual quality of the products constant. This effect presumably occurs because people evaluate the product relative to the local category rather than to all the products across all the categories. Leclerc et al. refer to this phenomenon as “narrow focusing.”

More generally, Read, Loewenstein, and Rabin (1999) suggest that, in making decisions involving multiple phases, people often fail to broadly assess all the consequences taken together and myopically focus on the most immediately available consequences. They refer to this phenomenon as “narrow bracketing,” and they use it to explain a wide range of research findings, including preferences for temporal sequences (e.g., Loewenstein and Prelec 1993; Read et al. 1999), risk aggregation (e.g., Benartzi and Thaler 1995; Thaler et al. 1997), mental accounting (Thaler 1985, 2000), attribute evaluability and joint-separate evaluation reversals (e.g., Hsee 1996; Hsee et al. 1999), and taste change (e.g., Herrnstein and Prelec 1992; Heyman 1996). In this research, we study this psychological myopia in the form of a medium effect. Furthermore, we identify factors that moderate this effect.

THE MEDIUM EFFECT

We define a medium effect as the difference in decision between two consequentially equivalent conditions, one with a medium (which we will refer to as the medium condition) and one without (which we will refer to as the control condition). For ease of discussion, let us consider the following simple medium and control conditions: In the medium condition, people are faced with two options (option 1 and option 2), each corresponding to a certain level of effort, a certain amount of medium, and a certain outcome. They are informed of the relationship between effort and medium and the relationship between medium and outcome, but not the relationship between effort and outcome. The control condition is the same as the medium condition, except that there is no medium and people are directly informed of the relationship between effort and outcome.

Which option will people choose in each condition? For ease of discussion, let E_1 and E_2 denote the disutility of effort associated with option 1 and option 2, respectively; O_1 and O_2 denote the desirability of the outcomes; and M_1 and M_2 denote the levels of medium.

In the control condition, we assume that people will simply compare the relative difference in effort between the options with the relative difference in outcome between the

options. Thus, their likelihood of choosing one option over the other, say, option 2 over option 1, can be modeled roughly as

$$L(\text{control}) = \frac{O_2}{O_1} - \frac{E_2}{E_1}. \quad (1)$$

The reason for using ratios rather than absolute differences is that people usually judge the advantage of one option over another in relative terms (Shafir, Osherson, and Smith 1993).

In the medium condition, our previous discussion on myopia and medium maximization suggests that people’s decision will be influenced not only by the final outcome but also by the medium. Thus, their likelihood of choosing option 2 over option 1 can be modeled roughly as

$$L(\text{medium}) = w \frac{M_2}{M_1} + (1 - w) \frac{O_2}{O_1} - \frac{E_2}{E_1}, \quad (2)$$

where the weight w , ranging between zero and one, indicates the degree to which the decision maker is influenced by the medium.¹

A comparison between equation 1 and equation 2 yields the following propositions. First, the presence of a medium may lead people to make different choices. That is, $L(\text{medium})$ may be different from $L(\text{control})$. We shall refer to this difference as the medium effect. Second, the mere presence of a medium is not sufficient to produce a medium effect. As equations 1 and 2 show, whether the presence of a medium leads to a medium effect depends on whether M_2/M_1 is different from O_2/O_1 . If it is not, then equation 2 will reduce to equation 1, and there will be no medium effect. We will elaborate on these propositions when presenting the experiments.

THREE CASES OF THE MEDIUM EFFECT

The medium effect manifests itself in different situations. In this article we focus on three types of situations that we believe are representative of many real-world decisions involving media. The first case is about a choice between a less effortful action and a more effortful action, where the more effortful action does not yield a much better outcome than the less effortful one. Here, the medium may give the more effortful action an illusion of advantage and lead more people to choose it. The second case is about options whose outcomes are uncertain. Here, the medium may give those options an illusion of certainty and increase their attractiveness. The last case concerns situations where the marginal return of effort diminishes over time, that is, the return function of effort is concave. Here, a medium may create an illusion of linearity and lead people to exert more effort.

¹These equations are not meant to be precise models; they are only approximations.

Of these three cases, the first is the most basic, and the latter two are extensions.

MEDIUM EFFECT CASE 1: THE ILLUSION OF ADVANTAGE

This section concerns situations where people choose between two options (say options 1 and 2), and the advantage of option 2 over option 1 in medium is large but the advantage in actual outcome is small. In other words, M_2/M_1 is large but O_2/O_1 is small.

This type of situation is reminiscent of many real-world decisions where moving from a less effortful action to a more effortful action (e.g., from a less demanding job to a more demanding one) may be highly advantageous in the medium (e.g., money) but not so advantageous in the final outcome (e.g., overall happiness).

In this type of situation, the medium gives option 2, which is originally not very advantageous to option 1, an illusion of advantage, and thereby will increase people's likelihood of choosing option 2. This prediction can be easily derived from equations 1 and 2. Because $L(\text{medium})$ is a function of both M_2/M_1 and O_2/O_1 , and $L(\text{control})$ is a function of only O_2/O_1 , it is obvious that when M_2/M_1 is greater than O_2/O_1 (and w is not equal to zero), $L(\text{medium})$ is greater than $L(\text{control})$. The above analysis leads to the following hypothesis:

H1a: When faced with two options (option 1 and option 2), where M_2/M_1 is greater than O_2/O_1 , people will be more likely to choose option 2 in the medium condition than in the control condition.

The effect described in hypothesis 1a will be referred to as a medium effect. If equations 1 and 2 are correct, then the following hypothesis will also hold:

H1b: The medium effect could be "turned off" if the M_2/M_1 ratio is made smaller and closer to the O_2/O_1 ratio.

Hypothesis 1b sets a boundary condition for hypothesis 1a, suggesting that the mere presence of a medium is not sufficient to generate a medium effect.

We now report three studies. Studies 1 and 2 are pilot studies, and they tested only hypothesis 1a. Study 3 tested both hypotheses 1a and 1b.

STUDY 1 (TASK/ICE CREAM)

Overview

The study involved a choice between a short task and a long task, each corresponding to a different flavor of ice cream as the reward (outcome). The amount of ice cream was kept constant (1 gallon). There were two between-subject conditions, control and medium. The relationships between task and outcome in these conditions can be summarized symbolically as follows:

Control condition:

Short task (6 minutes) → vanilla ice cream.

Long task (7 minutes) → pistachio ice cream.

Medium condition:

Short Task (6 minutes) → 60 points → vanilla ice cream.

Long Task (7 minutes) → 100 points → pistachio ice cream.

Notice that this design fits the characteristics of the situation discussed above, namely, $M_2/M_1 > O_2/O_1$. Here, $M_2/M_1 = 100/60$ or 1.67. In a pretest, we found that most students did not consider pistachio ice cream to be better than vanilla ice cream. Hence, it is reasonable to assume that O_2/O_1 is smaller than $M_2/M_1 = 1.67$.

Method

Ninety-six students from a midwestern university were approached on campus and told that they could participate in an experiment in the following week and receive 1 gallon of Haagen Dazs ice cream in return. They then filled out a questionnaire, ostensibly designed to gather information from potential participants. In the control condition, the respondents were told about the following week's experiment that they could choose between two similar tasks, one requiring six minutes and one seven minutes; that the flavor of the ice cream they would receive depended on which task they chose; and that they would receive vanilla ice cream, if they chose the short task, and pistachio ice cream, if they chose the longer task.

The medium condition was the same as the control condition, except that a medium was introduced: respondents were told that they would receive 60 points, if they chose the short task or 100 points, if they chose the longer task, and that, with 50–99 points, they would receive vanilla ice cream and with 100 or more points they would receive pistachio ice cream. They were also told that the points had no other value and were nontransferable.

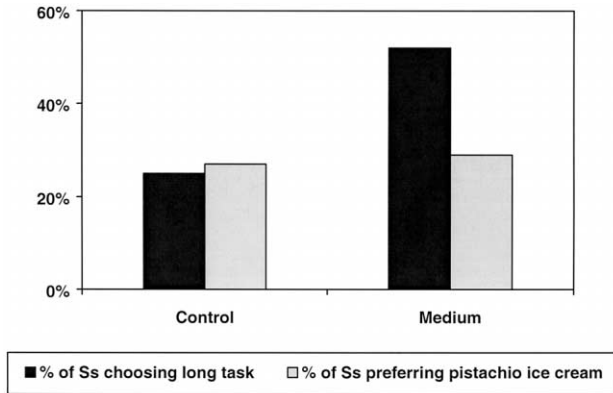
After having made their choices, respondents were also asked which type of ice cream they liked more. This question was designed to test whether the medium influenced judgments of the actual outcomes.

Results and Discussion

As summarized in figure 1, the result supports hypothesis 1a: more respondents chose the long task in the medium condition than in the control condition ($\chi^2 = 7.43, p < .01$). We consider this as preliminary evidence for medium maximization.

A possible alternative explanation for the finding is that respondents in the medium condition may have used points to infer the relative desirability of the ice creams and therefore chose the pistachio ice cream, which required more points. Had this been the case, then, in the subsequent ice cream preference question, those respondents should also have expressed a greater liking for pistachio ice cream than

FIGURE 1
STUDY 1 RESULTS



NOTE.—The percentage of participants choosing the long task is greater in the medium condition than in the control condition, although the percentage of participants preferring the outcome of the long task (pistachio ice cream) remains the same across the two conditions.

those in the control condition. But this is not what we found. As figure 1 shows, there was no difference. In both conditions, the respondents liked vanilla ice cream more. It seems that the presence of a medium may lead people to choose a longer task and end up with a less preferred outcome.

STUDY 2 (BANKING)

Overview

Study 2 replicates study 1 in a marketing-relevant context. It also includes a poststudy questionnaire to ensure that the respondents understood the instructions. The decision in the study was to choose between two branches of a bank at which to buy a certificate of deposit (CD). The outcome was a prize offered by the bank for buying the CD. There were two possible prizes: \$100 now or \$150 three years from now when the CD matured. The study had two between-subject conditions, which can be summarized as follows:

Control condition:

- Branch 1 (5 minutes away) → \$100 now.
- Branch 2 (6 minutes away) → \$150 three years from now.

Medium condition:

- Branch 1 (5 minutes away) → 100 points → \$100 now.
- Branch 2 (6 minutes away) → 150 points → \$150 three years from now.

Again, this design matches the characteristics conducive to a medium effect, namely, that $M_2/M_1 > O_2/O_1$. Here, $M_2/M_1 = 150/100 = 1.5$; $O_2/O_1 =$ the attractiveness of \$150 in three years/the attractiveness of \$100 now. In a

pretest, most students preferred \$100 now to \$150 in three years. Thus, O_2/O_1 is less than one and smaller than $M_2/M_1 = 1.5$.

Method

Respondents were 236 students from a midwestern university in the United States and an east coast university in China. Those in the control condition were asked to imagine that they had \$5,000 cash and planned to buy a three-year \$5,000 CD at one of two nearby branches of a large bank; one branch was five minutes away, and the other was six minutes away. In a one-day promotion, the bank was offering a prize for those purchasing a \$5,000 CD. The respondents were told that, if they bought the CD at the branch five minutes away, the bank would give them \$100 immediately, and if they bought the CD at the branch six minutes away, the bank would give them \$150 three years later when the CD matured. They were asked to assume that they only had enough money to buy one such CD. Their task was to decide at which branch to buy the CD.

The medium condition was identical to the control condition, except that a medium (points) was introduced between choice of branch and type of outcome. Respondents were told that, if they bought the CD at the branch five minutes away, the bank would give them 100 points, and if they bought the CD at the branch six minutes away, the bank would give them 150 points. They were also told that, if they had 100 points, the bank would give them \$100 immediately, and if they had 150 points, the bank would give them \$150 three years later when the CD matured. The points were said to have no other value. The decision was whether to buy the CD at the five-minute-away branch that would give them 100 points or the six-minute-away branch that would give them 150 points.

To test whether the respondents understood the instructions, we asked the following questions after they had made their choice. The first question (for both the control and the medium conditions) asked how many prizes one could possibly receive from the bank (the correct answer was one). The second question (also for both the control and the medium conditions) asked the respondents to recall the prize they would receive if they bought the CD at the branch six minutes away; the correct answer was \$150 three years later). The third question (only for the medium condition) asked whether the points had any other use besides allowing one to receive a cash prize; the correct answer was no). Of the 236 respondents, 23 respondents answered one or more of the questions incorrectly or did not answer all the questions, and they were excluded from the analysis. (Including these respondents in the analysis does not significantly change the results.)

Results and Discussion

Again, we found a medium effect. The proportion of respondents choosing the six-minute-away branch was sig-

nificantly higher ($\chi^2 = 18.66, p < .01$) in the medium condition (44%) than in the control condition (17%).

This study also rules out several potential alternative explanations for the medium effect of study 1 (Tasks/Ice Cream study). One is that the respondents may have misunderstood the instructions. This explanation is not likely for this study because the result is based only on respondents who answered all the poststudy questions correctly. Another alternative explanation is that points may have served as a cue to the desirability of the outcomes. Again, this explanation does not easily apply to study 2 because it is unlikely that people need to infer the desirability of "\$100 now" or "\$150 in three years" from points. A third alternative explanation for the medium effect in study 1 is that points may have served as a cue for the importance of the tasks. Because the long task in study 1 awarded more points than the short task, the respondents may have considered the long task to be more important and therefore chose that task. This explanation is less viable for study 2. Study 2 is a scenario study, and, in the scenario, the points were merely a means of promotion by the bank. It is unlikely that respondents used these points to infer the relative importance of their tasks: to bank at five-minute-away branch or six-minute-away branch.

STUDY 3 (SNICKERS/ALMOND JOY)

Overview

Study 3 extends studies 1 and 2 in two nontrivial directions. First, it included three medium conditions, with different M_2/M_1 ratios. This feature was designed to test hypothesis 1b, that concerning the boundary condition of the medium effect. Second, unlike the first two studies, where people with more points could not trade for the reward for fewer points, in study 3, people with more points could choose the reward for fewer points. This feature was designed to make the study more realistic. In real life, people with more medium typically have more options of outcomes. To hold this feature constant across all conditions, we introduced the flexibility not only to the medium conditions but also to the control condition.

This study contained the following four conditions:

Control condition:

Short task (20 minutes) → 1 pound of Snickers bars.
Long task (25 minutes) → choice of 1 pound of Snickers bars or 1 pound of Almond Joy bars.

Medium condition 1 (the 60/100 condition):

Short task (20 minutes) → 60 points → 1 pound of Snickers bars.
Long task (25 minutes) → 100 points → choice of 1 pound of Snickers bars or 1 pound of Almond Joy bars.

Medium condition 2 (the 60/61 condition):

Short task (20 minutes) → 60 points → 1 pound of Snickers bars.

Long task (25 minutes) → 61 points → choice of 1 pound of Snickers bars or 1 pound of Almond Joy bars.

Medium condition 3 (the color medium condition):

Short task (20 minutes) → a brown ticket → 1 pound of Snickers bars.

Long task (25 minutes) → a blue ticket → choice of 1 pound of Snickers bars or 1 pound of Almond Joy bars.

Notice that the final rewards associated with the tasks were held constant across all the conditions. The differences among the conditions lay in whether there was a medium and what the medium was. In the control condition, there was no medium, and O_2/O_1 was relatively small. Here, O_1 was the desirability of Snickers bars and O_2 was the desirability of a choice between Snickers bars and Almond Joy bars. In a pretest ($n = 81$), we found that most (71%) students preferred Snickers bars to Almond Joy bars. Therefore, the relative advantage of having the option of Almond Joy bars was small, and O_2/O_1 would not be much greater than one. In the 60/100 condition, the M_2/M_1 ratio was rather large (100/60). Thus, based on hypothesis 1a, we expected more people to choose the long task in this condition than in the control condition.

The remaining two medium conditions were designed to test hypothesis 1b, according to which the medium effect could be turned off by manipulating M_2/M_1 . In the 60/61 condition, the M_2/M_1 ratio was reduced to 61/60, close to one. In the color medium condition, the medium was simply colored tickets, and M_2/M_1 was either meaningless or one. Thus, we predicted that the medium effect found in the original medium condition would fade or vanish in the latter two medium conditions.

Method

This study was conducted in the dining hall of a southern university in the United States with 174 unpaid students. The method was similar to that used in study 1. The choices were to complete a 20-minute survey or a 25-minute survey. The outcome for completing the short task was to receive one pound of Snickers bars and that for the long task was to choose either 1 pound of Almond Joy bars or 1 pound of Snickers bars.

Other than what is described above, the control condition and the 60/100 condition were basically the same as the control and the medium conditions in study 1, respectively. The other two medium conditions were identical to the 60/100 condition, except that 60 points and 100 points were replaced with 60 points and 61 points, respectively, in the 60/61 condition, and with a brown ticket and a blue ticket, respectively, in the color medium condition.

After having made their decisions, participants were asked which type of chocolates they liked more. This question was

designed to replicate the observation in study 1 that the medium did not affect preferences for the outcomes.

Results and Discussion

The results are summarized in figure 2. As predicted in hypothesis 1a, more people signed up for the long task in the 60/100 condition than in the control condition ($\chi^2 = 18.8, p < .001$). As predicted in hypothesis 1b, the medium effect evaporated in the other two medium conditions ($\chi^2 < 1$ in both cases), thus leaving the 60/100 condition as the only one that was significantly different from the control. Further analyses reveal that the 60/100 condition differed not only from the control but also from the other two medium conditions ($\chi^2 = 13.47, p < .001$, from the 60/61 condition, and $\chi^2 = 12.81, p < .001$, from the color medium condition). These results not only replicate the medium effect but also show that the medium effect did not arise from the mere presence of the medium but from the illusion of advantage the medium creates.

The chocolate preference data collected at the end of the study revealed no significant differences between the control and any of the medium conditions, a result consistent with what we found in study 1. This study mimics real-life situations in which people can either exert less effort or more effort where the real advantage of exerting more effort is to have more options for reward, not more rewards. Normatively, what people ought to do is consider whether the extra options are any better than the existing ones, and if

they are not, then there is no need to make the extra effort. But what this experiment shows is that, when a medium is introduced, people may focus on the medium, and, if the payoff in medium from the extra effort seems relatively large, people will exert the extra effort, although the extra options in the reward set are of no extra value to them.

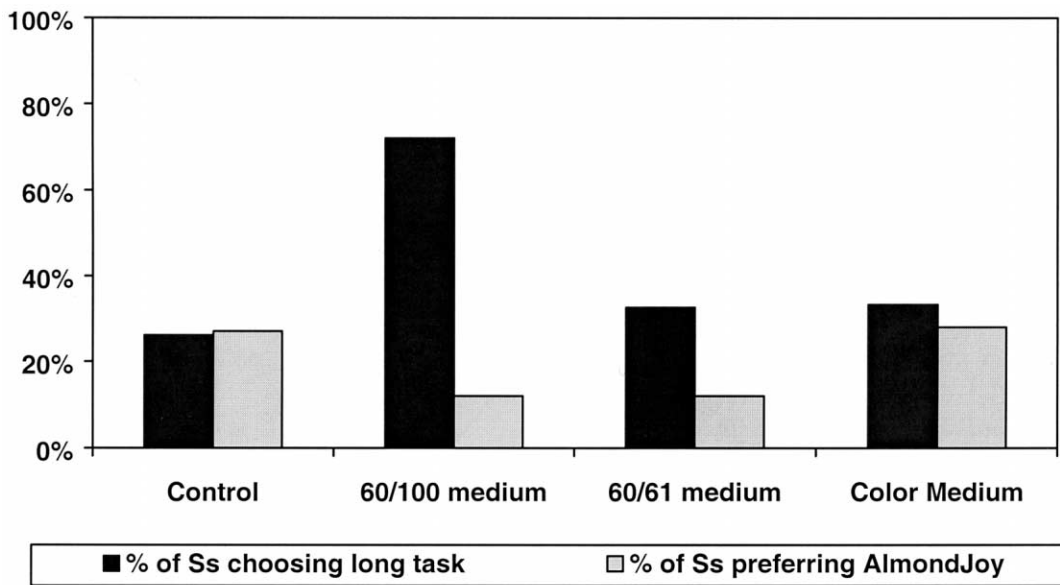
MEDIUM EFFECT CASE 2: THE ILLUSION OF CERTAINTY

This case is concerned with a choice between two options, where the outcome of one option is certain, the outcome of the other is uncertain, and the levels of medium in both options are certain. We propose that the medium in this case will create an illusion of certainty to the uncertain option and therefore increase its attractiveness. Specifically, we offer the following hypothesis:

H2: When faced with two choice options, one with a risky outcome, one with a sure outcome, and both with certain levels of medium in the medium condition, more people will choose the option with a risky outcome in the medium condition than in the control condition.

The following study tests this hypothesis.

FIGURE 2
STUDY 3 RESULTS



NOTE.—The percentage of participants choosing the long task is greater in the 60/100 medium condition (where the medium ratio between the long and the short tasks is high) than in any of the other conditions, although the percentage of participants preferring the outcome unique to the long task (Almond Joy) is no greater in that condition than in any of the other conditions.

STUDY 4 (STOCK/CASH)

Overview

The choice in this study was whether to quit a temporary job now, with a sure outcome, or to quit it in the following month, with a risky outcome. The outcome was money, and the medium was stock. The share price of the stock was \$1 now and would be either \$0 or \$2 in the following month. The two conditions of the study can be summarized as follows:

Control condition:

- Quitting now → \$1,000.
- Quitting in a month → \$0 or \$6,000 with even chance.

Medium condition:

- Quitting now → 1,000 shares of stock → \$1,000.
- Quitting in a month → 3,000 shares of stock → \$0 or \$6,000 with even chance.

We predicted that more people would work for the extra month in the medium condition than in the control condition because the medium (stock) transformed the original risky decision between a sure monetary payoff and an uncertain monetary payoff into a seemingly riskless decision between two apparently sure stock payoffs.

Method

Respondents (105 students from a southern university and a midwestern university in the United States) were asked to imagine that they had worked as a temporary assistant in a company for one month and that they had the option either to terminate the job now or to work one more month. For ease of exposition, let us first consider the medium condition. Respondents were told that they would only receive stock as their compensation and that they had to redeem their shares as soon as they received them. Respondents were further told that the stock value was \$1/share at the present time and would be either \$0 or \$2 per share with equal chance a month later and that if they terminated their job now, they would receive a total of 1,000 shares of stock, and if they worked one more month, they would receive a total of 3,000 shares.

In the control condition, there was no mention of the stock. The respondents were directly informed of the monetary consequence of their choices: the monetary figures were simply calculated from the corresponding stock values in the medium condition. Thus, the control and the medium conditions were identical in terms of the final outcome. In both conditions, the dependent variable was whether to quit now or to work one more month.

Results and Discussion

As expected, significantly more people ($\chi^2 = 10.30, p < .001$) opted to work one more month in the medium condition

(61%) than in the control condition (30%). In support of hypothesis 2, the medium (stock) indeed increased the popularity of the risky option. Presumably, the medium (stocks) endowed the risky option an illusion of certainty.

In real life, the outcome of an activity is often uncertain. What our findings suggest is that the introduction of a medium can create an illusion of certainty and thereby increase willingness to engage in the activity. For example, the actual benefit of physical exercises (e.g., jogging) is often uncertain. However, if people are awarded points every time they jog, they will probably be more motivated to perform the exercise. Indeed, some fancy heart-rate monitors can present joggers with feedback of how many calories they have burned. To some extent, the calorie readings serve as a medium, which makes people feel that for every unit of effort they exert, they are achieving a guaranteed reward—a jump in the reading, even though the actual outcome—benefit to their health—remains uncertain.

Thaler and Shefrin (1981) hypothesized that keeping track of one's calorie consumption has a self-control function and can lead people to eat less. This hypothesis is probably the flip side of the heart-rate-monitor effect discussed above. Just as telling people how many calories they have burned can motivate them to exercise, telling people how many calories they have gained can demotivate them to eat. In both cases, the calorie count serves as a medium that provides a sense of certainty to an otherwise uncertain outcome.

MEDIUM EFFECT CASE 3: THE ILLUSION OF LINEARITY

The two cases discussed so far are about choices between discrete options. The case to be discussed here is about when to terminate a continuous activity. In particular, the present case involves two properties. First, people continuously exert effort (or endure pain or incur cost) over time, and their decision is about when to terminate the ongoing process. Second, the marginal outcome of the activity diminishes over time. In other words, the outcome is a concave function of time. Again, this situation is representative of many real-world decisions, where the marginal return of effort diminishes over time.

Based on the medium maximization hypothesis, we propose the following hypothesis:

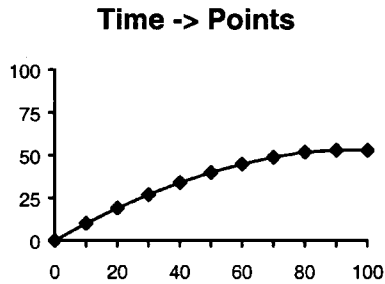
- H3a:** If the outcome of an ongoing aversive activity is a concave function of time but the payoff of the medium of the activity is a linear function of time, then people in the medium condition will engage in the activity longer than those in the control condition.

Here, the medium generates an illusion of linearity.

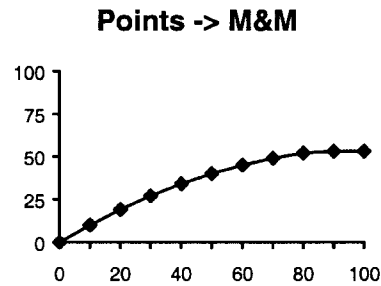
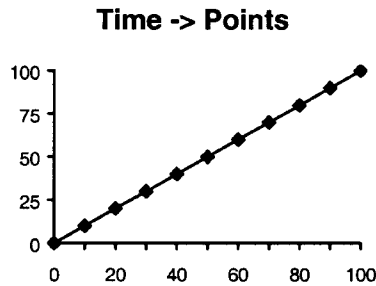
However, according to the medium maximization notion, the effect postulated in hypothesis 3a does not arise from the mere presence of the medium but from the fact that the medium payoff is more linear than the outcome. It implies that, if the medium payoff pattern is the same as the outcome

FIGURE 3
RELATIONSHIP AMONG TIME, POINTS, AND M&M'S IN STUDY 5

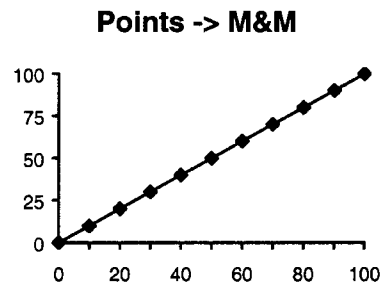
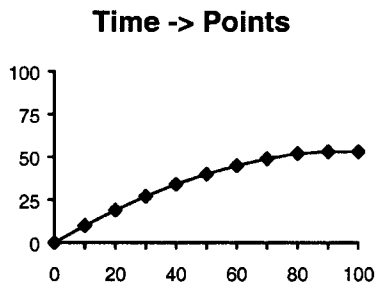
Control Condition:



Linear Medium Condition:



Concave Medium Condition:



NOTE.—In all the conditions, the M&M's payoff is a concave function of time. In the control condition, this concave relationship is transparent. In the linear medium condition, this concave relationship is masked by a linear relationship between points and time. In the concave medium condition, this concave relationship is again transparent.

payoff pattern, the medium effect would vanish. This leads to the following hypothesis:

H3b: If the payoff of the medium of the activity is the same concave function as the outcome, then there will be no medium effect.

The following study tested both hypotheses 3a and 3b.

STUDY 5 (NOISE/M&M'S)

Overview

The decision investigated in this study was when to quit listening to a noise emitted from headphones. The reward for listening to the noise was M&M's. The medium was points. The study consisted of three between-subject conditions—control, linear medium, and concave medium. Fig-

ure 3 presents a graphic summary of the three conditions. Note that the ultimate relationship between M&M's (outcome) and time (effort) was identical in all three conditions: it was concave.

Participants were informed of these relationships prior to the noise episode. While listening to the noise, they saw a readout of the number of M&M's (in the control condition) or of the number of points (in the two medium conditions) changing on a computer screen and could stop the noise at any time.

We had two predictions. First, people in the linear-medium condition would endure the noise longer than the control condition participants because the linear medium endowed the otherwise concave M&M's payoff function an illusion of linearity. Second, people in the concave-medium condition would not differ significantly from those in the control condition because the pattern of the medium here maintained the original M&M's payoff pattern.

Method

Participants (100 students from a large university in China) were asked to listen to an increasingly loud noise emitted from a set of earphones, and in exchange they would receive M&M's plus a fixed payment of 5 yuans (approximately 60 cents). M&M's were popular among college students there and were expensive relative to their living expenses.

Participants were run individually, each seated in front of a computer and wearing a pair of earphones. Once the noise started, the participant could terminate it at any time by pressing a key. The dependent variable was how long the participant would endure the noise before terminating it. The longer they endured the noise, the more M&M's they would receive. If the participant did not terminate the noise by the 150th second, the computer automatically stopped.

In the control condition, before the noise started, participants were told that, for the first 10 seconds they listened to the noise, they would earn 10 M&M's; for the second 10 seconds, nine M&M's; for the third 10 seconds, eight M&M's; and so forth. During the noise episode, they saw on the computer screen the number of M&M's they had earned.

In the linear medium condition, before the noise started, participants were told that, for every second they listened to the noise, they would earn one point, and that, for the first 10 points, they would earn 10 M&M's; for the second 10 points, nine M&M's; for the third 10 points, eight M&M's; and so forth. During the noise episode, they saw on the computer screen the number of points they had earned. As will be elaborated upon later, the prediction is that respondents in this condition would be willing to endure the noise longer than those in the control condition.

In the concave medium condition, prior to the noise episode, participants were told that, for the first 10 seconds they listened to the noise, they would earn 10 points; for the second 10 seconds, nine points; for the third 10 seconds,

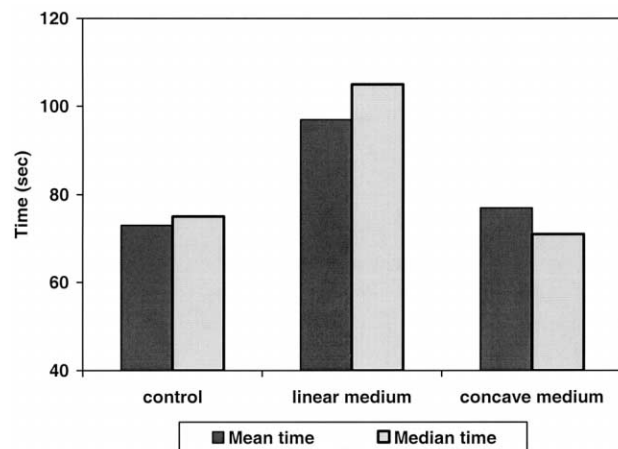
eight points; and so forth; and that, with every point, they would receive one M&M.

After the experiment, participants were asked how many M&M's they thought they would receive for the last 10 seconds they had listened to the noise. This question was designed to see whether the respondent's judgment matched the actual reward rate, as had been recorded by the computer. We consider a moderately inaccurate judgment acceptable because the inaccuracy may have resulted from the difficulty of remembering the duration of the noise or the difficulty of inferring the return rate from the readings on the computer screen. But if the judgment was too far from reality, which we consider as more than ± 3 from the correct answer, the respondent may have misunderstood the instructions. Nine respondents fell into this category and were excluded from analysis. Cutting the data at ± 2 or ± 3 does not significantly change the results.

Results and Discussion

The results (both the means and the medians) are summarized in figure 4. As predicted in hypothesis 3a, respondents in the linear medium condition endured the noise longer than those in the control condition ($t = 1.98, p = .05$, two-tailed test; $p < .05$, one-tailed test). As predicted in hypothesis 3b, respondents in the concave medium condition did not differ significantly from those in the control condition ($t < 1$, NS, one-tailed test or two-tailed test). Further analysis indicated that the linear medium condition differed not only from the control condition but also from the concave medium condition, though the effect was only marginally significant ($t = 1.70, p = .09$, two-tailed test; $p < .05$, one-tailed test). A planned contrast analysis that assigned a weight of 2 to the linear medium condition and a

FIGURE 4
STUDY 5 RESULTS



NOTE.—The amount of time for which participants are willing to endure the noise is greater in the linear medium condition than in either the control or the concave medium condition.

weight of -1 to the other two conditions yielded a significant result ($F(1, 88) = 4.61, p < .05$), which further confirmed the prediction that willingness to endure the noise was greatest in the linear medium condition.

Study 5 extends the previous studies to continuous behaviors and shows that the presence of a medium can indeed increase willingness to exert effort when the payoff function of the outcome is concave. It also demonstrates that the medium effect is not due to the mere presence of the medium but, rather, is due to the linear payoff pattern of the medium. If the payoff pattern of the medium is as concave as the outcome, there will be no medium effect.

Theoretically, neither the linear pattern of the medium nor the concave pattern of the outcome is a necessary condition for the medium effect. As long as the medium has a different payoff pattern than the outcome, there should be a medium effect.

Ecologically, however, the combination of a linear pattern of the medium and a concave pattern of the outcome is significant because it resembles many real-world work-money relationships, where (a) the amount of money people earn increases linearly as they work harder or longer, but (b) the utility function of the money is concave.

A SYNTHESIS OF THE THREE CASES

In this section, we examine the three cases. In the first case, a medium makes a not so advantageous option appear more advantageous. In the second case, a medium transforms a risky choice into a seemingly riskless one. In the last case, a medium turns a concave payoff relationship into a seemingly linear one.

Despite the apparent differences, the second and the third cases are variations of the first. In each case, the medium effect occurs because M_2/M_1 is greater than O_2/O_1 . To demonstrate this, consider the Stock/Cash study (study 4), which demonstrates the illusion-of-certainty effect. In that study, $M_1 = 1,000$ shares of stock, and $M_2 = 3,000$ shares of stock; $O_1 = v(\$1,000)$, and $O_2 = w(50\%)v(\$6,000)$, where v is the prospect theory value function and w is the prospect theory probability weighting function. Because the prospect theory value function is concave in the gain domain and $w(50\%)$ is typically no greater than 0.5 (e.g., Kahneman and Tversky 1979), it follows that $M_2/M_1 > O_2/O_1$.² This explains why people were more willing to work the extra month in the medium condition than in the control condition. The same analysis can be applied even to the Noise study (study 5) involving continuous behavior. Let O_1 and O_2 denote the numbers of M&M's earned at time t_1 and time t_2 , respectively ($t_2 > t_1$), and M_1 and M_2 denote the number of points earned at t_1 and t_2 , respectively.³ Then, for any $t_2 >$

²Note that even if we were to subject M_1 and M_2 to prospect theory's value function transformation, it would still hold that $v(M_2)/v(M_1) = v(3,000)/v(1,000) > O_2/O_1 = w(50\%)v(\$6,000)/v(1,000)$.

³Strictly speaking, O_1 and O_2 should denote the desirability of the number of M&M's at t_1 and t_2 , but the number of M&M's and its desirability are highly correlated within the range permitted in this study. Even if the two variables are not perfectly correlated, the basic analysis here will still hold.

10 seconds, the ratio M_2/M_1 in the linear medium condition was always greater than the ratio O_2/O_1 , as well as than the M_2/M_1 in the concave medium condition. This explains why the participants were more willing to endure the noise in the linear medium condition than in the other two conditions. These analyses illustrate the underlying similarity of the illusion-of-certainty and the illusion-of-linearity cases to the illusion-of-advantage case.

GENERAL DISCUSSION

People often make decisions in situations where the immediate outcome is a medium. In this article, we have demonstrated a systematic difference between choice with a medium and choice without a medium, and we have identified several boundary conditions of this effect. In this section, we discuss potential topics for future research and practical and theoretical implications of research on medium.

Potential Topics for Future Research

Research on medium can potentially encompass many interesting topics. The current research covers only a small subset of these topics, but we hope that it is seminal and that, along with other recent works in the area (e.g., Kivetz and Simonson 2002; Van Osselaer et al. 2001), it will generate interest for future research. The following are some potential topics. First, this article has focused only on three types of medium effects. We believe that a medium can exert its influence through other channels. For example, suppose that the actual outcome of a behavior has to be delivered long after the occurrence of the behavior. Then, if a medium is introduced and is delivered right after the occurrence of the behavior, it is likely to have a positive effect. This effect can be called the illusion of immediacy. Also, controlling for the actual outcome, a stream of medium that is dispensed in an ascending temporal sequence is likely to produce a different effect than a stream of medium that is dispensed in a descending temporal sequence (e.g., Van Osselaer and Alba 2000; see also Ariely 1998; Hsee and Abelson 1991; Loewenstein and Prelec 1993). This effect can be called the illusion of trend. In general, a medium is likely to have an effect on willingness to exert effort if the medium alters the perceived return of the effort.

Second, although we have defined medium narrowly as an instrument used to trade for something else, our findings may be generalized to a more broadly defined medium—any proxy representation for a more fundamental value. For example, a student's GRE score can be considered as a medium for her chance of being admitted to a desired graduate program (outcome) and a professor's number of publications can be considered as a medium for his contribution to the field (outcome). Just as a narrowly defined medium can create illusions of advantage, certainty, or linearity for the outcome, so can a proxy variable create such illusions for the more fundamental value.

Third, future research may investigate other moderators of the medium effect than what this research has identified.

Generally, factors that lead people to focus their attention on the medium phase will enhance the medium effect. One such factor is cognitive load. Cognitive load will limit people's mental capacity to see beyond the immediately available layer and thereby increase the influence of the medium.

Another such factor is the mental effort needed to figure out the amount of medium for each option. The more effort it requires, the more people will focus their attention on the medium phase, and the greater will be the medium effect. A study we recently conducted lent preliminary support to this idea. The study involved one control condition (without points) and two medium conditions (with points). In all conditions, there were three choice options, and the corresponding outcomes were similarly attractive. In the two medium conditions, the three options entailed different numbers of points. In one of the medium conditions (the easy-medium condition), which option corresponded to how many points was transparently given. In the other medium condition (the difficult-medium condition), which option corresponded to how many points was not readily given; the research participants had to follow a specified calculation rule to figure out the relationship by themselves. Two results emerged from this study. First, those in the easy-medium condition were more likely to choose the option with the most number of points than were those in the control condition. This is merely a replication of the regular medium effect. Second, confirming our speculation about effort and the medium effect, the tendency to choose the option with the most number of points was even greater in the difficult-medium condition than in the easy-medium condition. It seems that people who exert effort to deal with the intricacies of media are more susceptible to the influence of the media and more oblivious to the final outcomes.

It should be noted that the moderators discussed above are different from the moderators in the Snickers/Almond Joy study (whether the medium ratio was 60/100 or 60/61) and in the Noise/M&M's study (whether the medium return was linear or concave). To appreciate the difference, let us revisit our definition of the medium effect. We have defined the medium effect as the difference in choice between the medium and the control conditions, namely, the difference between

$$L(\text{medium}) = w \frac{M_2}{M_1} + (1 - w) \frac{O_2}{O_1} - \frac{E_2}{E_1} \quad (2)$$

and

$$L(\text{control}) = \frac{O_2}{O_1} - \frac{E_2}{E_1}. \quad (1)$$

These equations suggest that the medium effect can be moderated by two types of factors: those influencing the size of M_2/M_1 and those influencing the size of w . The moderators in the Snickers/Almond Joy study and in the Noise/M&M's study concern M_2/M_1 . On the other hand, the factors we proposed in this section—attention and cognitive load—

concern w . Since the current research has studied M_2/M_1 more extensively, future research should focus more on w .

Finally, future research should shed more light on the psychological process underlying the medium effect. Our preferred explanation of the effect is psychological myopia; it is most consistent with the diverse literatures reviewed earlier. According to that explanation, the effort \rightarrow medium relationship is more directly related to one's decision than the medium \rightarrow outcome relationship, and therefore exerts a greater impact.

We now entertain two other explanations. One also attributes the medium effect to the excessive influence of the effort \rightarrow medium relationship, but it attributes the excessive influence not to myopia but to people's preference for objective over subjective information (see Hsee et al. [forthcoming] for evidence for this preference). Typically, which option brings more medium (the effort \rightarrow medium relationship) seems more objective and unequivocal than which medium level brings the better outcome (the medium \rightarrow outcome relationship); therefore it exerts more influence. However, this explanation seems incompatible with the results of the Noise/M&M's study, in which the number of M&M's is as unequivocal as the number of points. Another explanation attributes the medium effect merely to people's preference for more medium. Obviously, the first two explanations also rely on the assumption that people prefer more medium but that they combine that preference with myopia and preference for objective information. The last explanation treats the preference for more medium as a sufficient cause for the medium effect. This explanation seems most parsimonious, but it also seems too general and amorphous to be satisfactory. Regardless of its ultimate explanation, the medium effect, we believe, is an interesting and fertile topic, and it entails both practical and philosophical implications, which we discuss next.

Implications

The practical implications of the current research are obvious. For instance, it can help organizations devise token reinforcement systems to boost worker motivation. It can also assist marketers in designing point-awarding frequency programs to enhance consumer loyalty. Frequency programs have become ubiquitous in recent years, and researchers have identified many factors that contribute to their popularity (e.g., Kivetz and Simonson 2002; Van Osselaer et al. 2001). The current work provides an additional perspective: marketers can stimulate purchasing behavior by manipulating the way the medium in such a program—for example, points or credits—is distributed.

More importantly, the current work delivers broader philosophical implications. Although in this article we have treated things such as candies and money as "outcomes," they are actually also media. Arguably, the ultimate outcome of any action is affective experience—broadly defined, happiness. Anything between our behavior and happiness is a medium. This proposition leads to some interesting corollaries:

First, there are typically multiple layers of media between

our behavior and the ultimate outcome—happiness. For example, when a frequent-flyer-program member flies, he accumulates miles. He then redeems the miles for a free airline ticket. With the ticket, he takes a vacation. He then derives happiness from the vacation. Here, miles, the ticket, and even the vacation can all be construed as media, as illustrated below:

Flying → miles → ticket → vacation → happiness.

As another example, consider a student who uses the money she has earned from work to purchase a camera, then takes photos, and then derives joy from looking at the photos. Here, the money, the camera, and even the photos are all media:

Work → money → camera → photos → happiness.

Indeed, we are surrounded by media—multiple layers of media. If you are “digitally correct,” you may say that life is a “multimedia system.”

Second, although this research has focused primarily on the relationship between narrowly defined media (e.g., points) and their immediate outcomes (e.g., candies), its implications are much broader and are applicable to the relationship between any layer of medium in the “multimedia system” and the ultimate outcome, happiness. Social scientists have observed that people in industrialized countries have been working harder and harder and accumulating more and more wealth, yet their happiness has not increased appreciably (e.g., Diener and Biswas-Diener 2002; Easterlin 2001; Frank 1999; Frey and Stutzer 2002; Schor 1993; Veenhoven 1993). Although these observations have received numerous interpretations (e.g., Brickman and Campbell 1971; Scitovsky 1992; see also Kahneman, Diener, and Schwarz 1999), the current research provides a new perspective. Typically, the longer or harder we work, the more money and material goods we can receive. In other words, the relationship between work and wealth/material goods is usually riskless and linear. However, the relationship between money/material goods and ultimate happiness is usually uncertain and concave. What the current research suggests is that money/material goods can serve as a medium that creates illusions of certainty and linearity. Thus, people, who focus on these media are likely to overwork and overaccumulate money/material goods.

In this article, we have portrayed the pursuit of an inherently worthless medium as if it were a mistake. But it may not be. The accumulation of a medium, especially when it requires effort, may engender a sense of accomplishment and self-efficacy (e.g., Bandura 1982) and generate joy in and of itself. It may also enhance the enjoyment of the reward, as the reward may be perceived as a self-gift for the accomplishment (e.g., Mick and DeMoss 1990). If these conjectures hold, then it is not irrational to pursue media.

For many people, happiness comes not only from the end of the effort → multimedia → happiness chain but also from

amid the multimedia phases. In a way, the multimedia chain is like an onion. An onion is a multilayer entity. When a person peels off a layer, his action can be considered as a means to accessing the heart of the onion. But there is not really a heart. If people resist the temptation to enjoy each layer as they peel inward, then there will be nothing left to enjoy once they reach the center. To enjoy an onion is to enjoy its layers. To enjoy life is to enjoy its media.

[David Glen Mick served as editor and Joel Huber served as associate editor for this article.]

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