Exploring the value of a novel decision-making theory in understanding R&D progress decisions

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Abstract

Purpose – The purpose of this article is to explore the ability of a novel psychological theory of how people make decisions, narrative-based decision theory, to help explain people's decisions about whether to continue investment in a research and development (R&D) project (R&D progress decisions).

Design/methodology/approach – The paper applies the new theory to an empirical finding of existing research on R&D progress decisions; the finding that instruction in the sunk cost principle seems to mitigate the sunk cost effect in R&D progress decision-making.

Findings – By interpreting the empirical finding in terms of narrative-based decision theory, the paper is able to clarify and extend an earlier explanation for the empirical finding. More specifically, by drawing on narrative-based decision theory the paper is able to provide a more detailed explanation of how the predictor variable (sunk cost) and the moderator variable (instruction in the sunk cost principle) may exert an influence.

Research limitations/implications – Based on the result of the exploration, the authors call for further investigations into narrative-based decision theory's value in explaining R&D progress decisions, and other management decisions.

Practical implications – Furthermore, the authors call for investigations into how narrative-based decision theory may help decision-makers in improving the quality of R&D progress decisions.

Originality/value – Narrative-based decision theory is a recent theory from the field of naturalistic decision-making. To the authors' knowledge, this is the first article that, by using an example, illustrates how the theory may help in explaining the findings of empirical research on management decisions.

Keywords R&D investment decisions, Naturalistic decision-making, Narrative-based decision-making theory, Sunk costs, Research and development

Paper type Conceptual paper

What is actually happening inside a manager's mind when deciding whether to continue investment in a R&D project? And would having more insight into the cognitive process that takes place when people make such a decision help to better understand people's R&D progress decisions? It is these questions that inspired us to

First, the authors would like to thank the people engaged in R&D activities that they have talked to in the past years. The authors would also like to thank Lee Roy Beach, Tijs de Bree, Michael Song and Hal Arkes for their helpful comments on earlier drafts of this paper. In addition, they are grateful to Donald Conlon and Henry Moon for the quick response to their request for the raw data.

Management Decision
Vol. 51 No. 1, 2013
pp. 184-199

0025-1747
DOI 10.1108/00251741311291382

explore the value of a novel theory of how people make decisions, narrative-based decision theory (Beach, 2009a, b, Beach, 2010), in understanding people's R&D progress decisions. In this article, we do so by interpreting a finding of existing empirical research, the finding that instruction in the sunk cost principle seems to mitigate the sunk cost effect in R&D progress decision-making (Harrison and Shanteau, 1993; Tan and Yates, 1995), in terms of narrative-based decision theory. Our rationale for interpreting a finding of existing empirical research in terms of narrative-based decision theory, is that for narrative-based decision theory to be of explanatory value, the theory should be able to help explain findings of empirical research on R&D progress decisions. The first reason why we have chosen the finding just mentioned, is that the effect of sunk costs on the outcome of R&D progress decisions has been examined extensively, and remains a subject of vigorous debate (McAfee *et al.*, 2010; Butler, 2010). The second reason is that by choosing a moderating effect, instead of a regular effect, narrative-based decision theory is confronted with a more complex exercise. The third reason is that existing empirical work already provides an explanation for how instruction in the sunk cost principle may mitigate the effect of sunk costs (Larrick *et al.*, 1990). This gives us the opportunity to explore more deeply whether narrative-based decision theory may be able to advance our understanding beyond what is already known, since the theory must then, besides interpreting the finding in its own terms, also account for an already existing explanation of the empirical finding.

In this article we present the result of our exploration. Our approach is as follows. First, we infer how people, according to narrative-based decision theory, choose between alternative courses of action. Subsequently we introduce the empirical finding of our interest. Then, by integrating the theory's view of how people choose between alternative courses of action, and a current explanation of how instruction in the sunk cost principle prevents the sunk cost effect from occurring, we offer a more detailed explanation. Based on this result, we end by calling for further investigations into the theory's value in understanding people's R&D progress decisions, and other management decisions.

The NBDT view

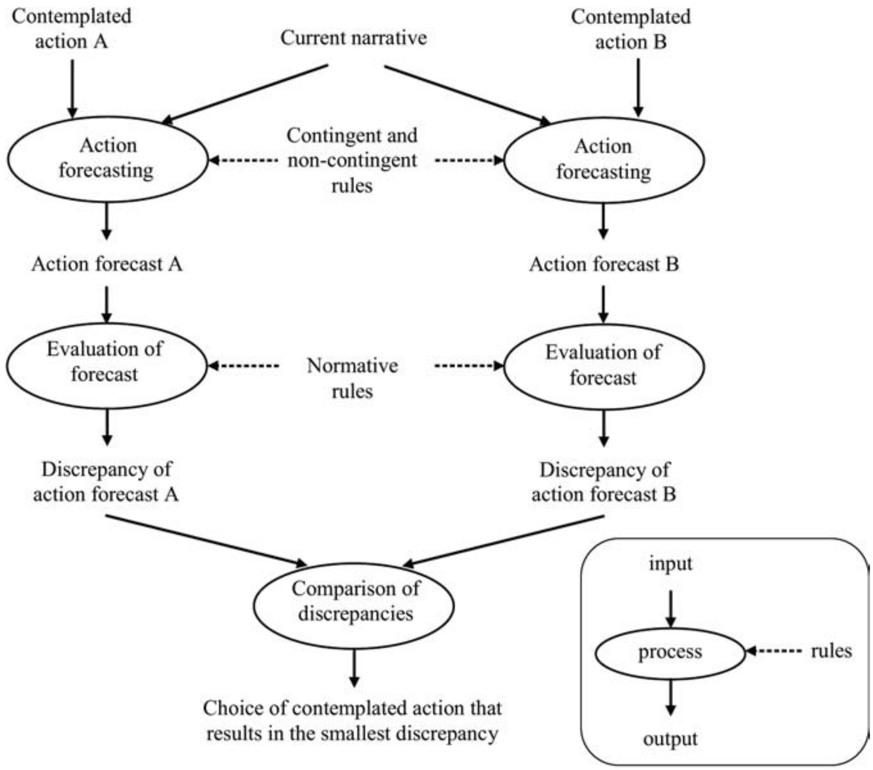
In this section we introduce narrative-based decision theory's view of how people decide whether to continue investment in a research and development project. Narrative-based decision theory (Beach, 2009a, b; Beach, 2010)[1]. is a recent theory from the field of naturalistic decision-making. A central goal in the field of naturalistic decision-making (NDM) research is to understand how people actually make decisions in real-world settings (Klein *et al.*, 1993; Kahneman and Klein, 2009). In this field, a number of models of decision-making have been proposed. In a first review of NBM models, Lipshitz (1993) showed that there was considerable affinity between the then existing models. However, he also noted that the models only provided a partial answer to the question of how people actually decide in real-world settings. In a later review, the challenge to develop more comprehensive models and theories was repeated (Lipshitz *et al.*, 2001). The aim in developing narrative-based decision theory has been to address this issue and to provide a general psychological theory on decision-making. The result has been a theory that describes how people make a wide range of decisions, ranging from intuitive or unconscious decisions to the complex decisions that keep people awake at night. The theory can be regarded as a fairly straightforward elaboration of image theory (Beach and Mitchell, 1987; Beach, 1990), one of the earlier NDM models that has served as a theoretical basis for many laboratory experiments (for an overview see Beach and Connolly, 2005; Beach, 2009b), and also for theory papers about decisions such as those to voluntarily leave an organization (Lee and Mitchell, 1994) or to retire early (Feldman, 1994). An important difference between image theory and its successor, narrative-based decision theory, is that the latter has been heavily influenced by the concept of narrative thought (Bruner, 1991), and also draws on concepts from other decision-making models.

Narrative-based decision theory's view of decision-making is built on the notion that decision-makers' current narratives play a key role in decision-making. Greatly simplified, decision-makers' current narratives are the stories they tell themselves (both consciously and unconsciously) about what happened in the past and what is happening in the present. It is a rich mixture of memories and cognitive images that enable a person to forecast what will happen in the future. According to narrative-based decision theory, decision-making is "the act of evaluating the desirability of the forecasted future and, when it falls short of our values and preferences, choosing appropriate interventions to ensure that the actual future is more desirable than the forecasted future (Beach, 2009b, p. 6)".

In this paper, we use constructs from narrative-based decision theory to model the cognitive process that takes place when a person makes an R&D progress decision. Our approach begins with the notion that the decision we are focusing on can be regarded as a choice between two alternative courses of action: allocate additional resources to an R&D project, or abandon the R&D project[2]. Narrative-based decision theory models choosing between two alternative courses of action as a process consisting of: forecasting what the future will look like for each contemplated action; evaluating the discrepancy between the forecasts and the decision-maker's values and preferences; and selecting the contemplated action that leads to the smallest discrepancy. Figure 1 presents the process model that we have derived from narrative-based decision theory.

In the first part of the process, labeled action forecasting in Figure 1, the decision-maker's current narrative, contemplated actions, and contingent and non-contingent rules all play a central role. Simplified, the decision-maker's contingent rules tell the decision maker what to expect as a result of something he or she does, whereas the decision maker's non-contingent rules tell the decision maker what to expect as a result of actions by other people and nature. Action forecasting is achieved by applying the contingent and non-contingent rules to the current narrative while assuming that one of the contemplated actions is implemented. The result is a forecast, referred to as an action forecast, showing what the future might look like if a contemplated action is implemented.

In the second part of the process, labeled evaluation of forecast in Figure 1, the decision-maker's action forecasts and normative rules play a central role. Essentially, a decision-maker's normative rules tell the decision maker what is and what is not desirable. An action forecast is evaluated by applying the normative rules to it. The result is an assessment of the discrepancy between the action forecast and what the decision-maker's normative rules determine as desirable, referred to as the discrepancy of the action forecast. Thus, the result of the evaluation informs the decision-maker



Source: Derived from Beach (2009b)

Figure 1.
NBDT's view of choosing between two alternative courses of action

how desirable or otherwise the future offered by the action forecast is. The first two steps, action forecasting and forecast evaluation, are completed for both the contemplated actions (in our case "allocating additional resources to the R&D project" and "abandoning the R&D project").

In the third part of the process, labeled comparison of discrepancies in Figure 1, the discrepancies of the two action forecasts are compared. This comparison allows the decision-maker to select the contemplated action that is expected to lead to the smallest discrepancy or, in other words, the contemplated action that is expected to lead to a future that is least inconsistent with the decision-maker's normative rules. Thus, according to narrative-based decision theory, choosing between alternative courses of action does not entail a comparison of contemplated actions, or action forecasts, but rather a comparison of the discrepancies of action forecasts. Before proceeding to the next section, where we introduce the empirical finding to which we will apply the process model of Figure 1, we should stress that narrative-based decision theory is much richer and more detailed than our application of the theory may suggest.

A finding from the RBP experiments

Imagine you are observing the president of Ener-Helio Corporation, a solar cell manufacturer. During the past three years her company has spent several million dollars on a research and development project to develop a new type of solar cell. A week has passed since a large competitor announced it was developing a similar solar cell. There are clear signs that the competitor's solar cell will be superior to Ener-Helio's one. At this moment, the president is staring out the window. She is deciding whether she should allocate the next million to her company's R&D project, or abandon the project.

One of your thoughts as an observer could be that Ener-Helio's president is in a situation of escalating commitment. Escalating commitment situations have been characterized as ones in which a choice has to be made about whether to continue an endeavor having already invested, and receiving negative feedback suggesting that, at the very least, the goal is not yet attained, with uncertainty surrounding the likelihood of achieving it (Brockner, 1992; Staw, 1976). As the phrase implies, it is not uncommon for managers to escalate commitment in a situation like Ener-Helio's president is in (Schmidt and Calantone, 2002). Sharing this thought with the president could make her turn towards you and say: "Interesting point. Please continue. Why would someone like me, with a degree in electrical engineering, mistakenly allocate additional resources to an R&D project?".

For an answer this question we turn to the results of three experiments in which participants were confronted with a decision task similar to the one described previously (Arkes and Blumer, 1985). The experiments were part of Arkes and Blumer's research into the effect of sunk costs, i.e. past costs, on a decision-maker's willingness to continue an endeavor. The results of the three experiments showed that once an R&D project had incurred costs, participants were more willing to allocate resources than when the same R&D project had yet to incur any costs. These were remarkable findings since the sunk cost principle from microeconomics tells us that only the future revenues and costs that vary between alternative courses of action are relevant when making choices and that, therefore, sunk costs are irrelevant (Horngren *et al.*, 2006; Horngren *et al.*, 2007).

Since then, various researchers have re-used the scenario of Arkes and Blumer's experiment, also referred to as the Radar-Blank Plane scenario (Garland, 1990; Garland and Newport, 1991; Conlon and Garland, 1993; Tan and Yates, 1995; Garland and Conlon, 1998; Arkes and Hutzel, 2000; Higgins *et al.*, 2001; Moon, 2001a, b, Tan and Yates, 2002, Van Dijk and Zeelenberg, 2003; Moon *et al.*, 2003; Wong *et al.*, 2006; He and Mittal, 2007; Wong *et al.*, 2008; Harvey and Victoravich, 2009; Van Putten *et al.*, 2010; Harrison and Shanteau, 1993). Over time, researchers have made small changes to the scenario but its essence remains. An example of the scenario is as follows:

> You are the President of Aero-Flite Corporation, an airplane manufacturer. You have spent __ million dollars of the 10 million dollars budgeted for a research project to develop a radar scrambling device that would render a plane undetectable by conventional radar (in effect a radar-blank plane). The project is __ per cent complete. Another firm has begun marketing a similar device that takes up much less space and is much easier to operate than Aero-Flite's (Garland, 1990, p. 729).

After having read the scenario, participants in a Radar-Blank Plane (RBP) experiment have to decide whether to allocate additional resources to the R&D project or abandon the R&D project. By manipulating the sunk cost information in the scenario, i.e. the amount of money already spent, researchers have been able to examine the relationship between sunk costs and the participants' decisions. Similarly, other pieces of information have also been associated with the outcome of the participants' decisions.

For example, information about project completion (Conlon and Garland, 1993), competitor's performance (Conlon and Garland, 1993), responsibility (Wong *et al.*, 2006), and decision risk (He and Mittal, 2007). Further, by measuring participants' personality traits researchers have shown that, besides differences in the information provided, also differences in personality traits are associated with the decisions made by participants. Here we refer to differences in duty, which is the extent to which a person adheres to ethical principles and moral obligations, and differences in achievement striving, which is the extent to which a person has high aspiration levels and works hard to achieve his or her goals (Moon, 2001b).

Overall, when it comes to the magnitude of the sunk cost effect, i.e. the effect size, the results from the Radar-Blank Plane experiments present a mixed picture. When looking at those studies that do not confound sunk costs with project completion (see Conlon and Garland, 1993), it becomes clear that the observed effect sizes, in terms of Pearson's r, differ across experiments (Conlon and Garland, 1993; Tan and Yates, 1995; Garland and Conlon, 1998; Moon, 2001a; Van Dijk and Zeelenberg, 2003). The Appendix provides an overview of the observed effect sizes in the Radar-Blank Plane experiments referred to. It shows that the observed effect sizes are both positive and negative, and range from small to large. While the list of experiments in the Appendix might not be exhaustive, and we are unable to report exact values for some of the experiments listed, the overview of observed effect sizes confronts us with a question: What explains the difference between the effect sizes across experiments?

One plausible explanation is that the relationship between sunk costs and the outcome of R&D progress decisions is moderated by other variables. An example of such a moderator variable is decision-makers' educational background or, more precisely, prior instruction in the sunk cost principle (Harrison and Shanteau, 1993; Tan and Yates, 1995). In a first study by Harrison and Shanteau (1993) cost accounting students who had received instruction in the sunk cost principle were, in the presence of sunk costs, somewhat less likely to allocate additional resources to the radar-blank plane project than introductory psychology students who had not received such instruction ($r = 0.19; \chi^2(1, n = 87) = 2.98, p = 0.08$)[3]. In a second study, in which the scenario also included an attractive alternative use of the funds, the effect size was however nearly zero ($r = 0.02; \chi^2(1, n = 85) = 0.03, p = 0.87$). In two later studies, Tan and Yates examined the moderating effect of instruction in the sunk cost principle more thoroughly (Tan and Yates, 1995). Besides varying participants' educational background, they also manipulated the sunk cost information in the scenario. In a first study, the effect of sunk costs on the decisions of students with a management accounting background was considerably weaker than the effect of sunk costs on the decisions of students without a management accounting background ($r = 0.08$; $\chi^2(1, n = 41) = 0.29, p = 0.59$, versus $r = 0.59; \chi^2(1, n = 50) = 17.53, p < 0.001$). In a second study, in which the scenario also included estimates of expected future revenues and costs (indicating a net return of five million dollar), the difference between the effect sizes was however quite small ($r = 0.13$; $\chi^2(1, n = 48) = 0.76$, $p = 0.38$, versus $r = 0.16; \chi^2(1, n = 50) = 1.29, p = 0.26$).

According to the four experiments of Harrison and Shanteau (1993) and Tan and Yates (1995), one explanation as to why Ener-Helio's president might escalate her commitment is that she could fall victim of a sunk cost fallacy due to a lack of instruction in the sunk cost principle. In the following pages, it is this finding of existing empirical work on R&D progress decisions, diagrammed in Figure 2, that we will explore through the lens of the process model shown in Figure 1.

Expanding on the underlying mechanism

Drawing on the process model of how people choose between two alternative courses of action, we develop, in this section, a more detailed explanation of how instruction in the sunk cost principle may prevent the sunk cost effect from occurring. We do this in two steps. First, we explain how, in terms of the process model, sunk costs may affect the outcome of a person's R&D progress decision. Subsequently, we combine this explanation with an earlier explanation as to how instruction in the sunk cost principle may prevent the sunk cost effect from occurring. The result is a clarification and extension of the earlier explanation (shown in Figure 3).

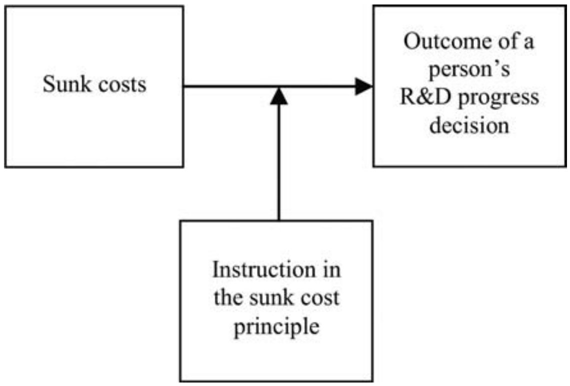
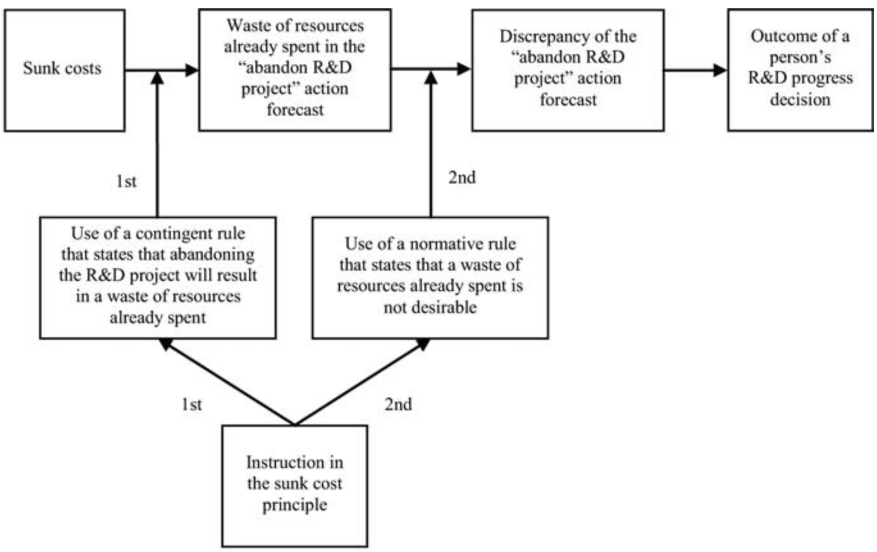


Figure 2.
The empirical finding that is explored through the lens of Figure 1



Note: Numbers correspond to the paths of moderation

Figure 3.
A clarification and extension of Larrick *et al.*'s explanation for the finding

Before we can use the process model from Figure 1 to show how the sunk cost effect may occur in R&D progress decisions, we first need to locate sunk costs in the process model. These are to be found in the decision-maker's current narrative. As noted earlier, the current narrative is the story decision-makers tell themselves about what happened in the past and what is happening in the present. Thus, if a decision-maker knows that a lot of money has already been spent on a R&D project, this information is part of the decision-maker's current narrative on the R&D project. This is an important notion because, following the logic of the process model, the content of the current narrative affects the content of the action forecasts which, in turn, affects the discrepancies of the action forecasts which then, in turn, affect the decision-maker's choice between the two alternative courses of action (see Figure 1). Now, having located sunk costs in the process model, we can infer how sunk costs, as a feature of a decision-maker's current narrative, may lead a decision-maker to opt for allocating additional resources to an R&D project (and choosing not to abandon the R&D project). Following the logic of the process model, sunk costs cause a decision-maker to choose to allocate additional resources to an R&D project if those sunk costs, as a feature of the decision-maker's current narrative, create a difference between the decision maker's action forecasts such that the "abandon the project" action forecast is more discrepant than the "allocate additional resources" action forecast.

The previous reasoning suggests two ways through which the sunk cost effect may be prevented, and that, following the logic of the process model, are relevant in understanding how instruction in the sunk cost principle may exert a moderating influence. First, such instruction may prevent the sunk costs, as a feature of the decision maker's narrative, leading to a difference between the decision-maker's action forecasts. Second, this instruction may prevent the action forecast for the "abandon project" action being more discrepant than the action forecast for the "allocate additional resources" action. Continuing with the logic of the process model and narrative-based decision theory's conception of contingent, non-contingent, and normative rules, in the first path of moderation instruction prevents the use of a contingent or non-contingent rule that creates the difference between the two action forecasts, whereas in the second path of moderation instruction prevents the use of a normative rule that makes the "abandon project" action forecast more discrepant than the "allocate additional resources" action forecast. It is through these two paths that the process model suggests that instruction in the sunk cost principle may exert its moderating influence on the sunk cost effect in R&D progress decisions. This line of reasoning fits with narrative-based decision theory's view on the origins of a decision-maker's contingent, non-contingent, and normative rules since, according to the theory, such rules can be acquired through experience or instruction.

The question that now arises is which rules are prevented from operating in the two paths of moderation? For an answer to this question, we turn to an earlier explanation as to how instruction in the sunk cost principle may prevent the sunk cost effect from occurring (Larrick *et al.*, 1990), and integrate it with the previous reasoning. The results of the experiments by Larrick *et al.* (1990) suggest that the answer lies in the "don't waste" explanation of the sunk cost effect. The "don't waste" explanation of the sunk cost effect is a well-known explanation of the sunk cost effect (for reviews of explanations see: McAfee *et al.*, 2010; Brockner, 1992; Staw, 1981; Arkes and Ayton, 1999; Friedman *et al.*, 2007). According to the "don't waste" explanation of the sunk cost effect, decision-makers are affected by sunk costs because they overgeneralize a normative rule known as the "don't waste" rule (Arkes and Blumer, 1985; Arkes and Ayton, 1999). The "don't waste" rule states that wasting resources is undesirable. It is argued that decision-makers who are affected by sunk costs extend the "don't waste" rule from resources not yet spent (to which it should refer) to include resources already spent and, in so doing, create a new, economically unsound, normative rule that leads to the sunk cost effect: a rule that states that wasting resources already spent is undesirable. One of the experiments by Larrick *et al.* (1990, pp. 367-8) showed that participants who had been instructed in the sunk cost principle were considerably less likely to think that the desire not to waste resources already spent is an economically sound normative rule. This suggests that instruction in the sunk cost principle may prevent the sunk cost effect from occurring by preventing decision makers from using a normative rule that states that a waste of already-spent resources is not desirable. It is here that Figure 1 helps provide a more complete explanation. In terms of the process model, the second path of moderation would look as follows:

> *Second path of moderation*: instruction in the sunk cost principle moderates the sunk cost effect in R&D progress decision-making, by preventing decision-makers from using a normative rule that states that a waste of already-spent resources is not desirable, *which in turn, avoids an increase in the discrepancy of the decision makers' "abandon R&D project" action forecast*. (The italic part is what we can add to Larrick et al's explanation by looking through the lens of Figure 1.)

However, as noted earlier, instruction in the sunk cost principle may, according to the logic of the process model, also exert a moderating influence by preventing the use of a contingent or non-contingent rule. More precisely, a contingent or non-contingent rule that includes sunk costs, and that, when used, creates a difference between the decision maker's action forecasts such that the "abandon the project" action forecast is more discrepant than the "allocate additional resources" action forecast. Following the logic of the "don't waste" explanation for the sunk cost effect, the difference between the decision maker's two action forecasts would be a difference in terms of wasted resources. More specifically, the "abandon project" action forecast would show the resources already spent as a waste, whereas the "allocate additional resources" action forecast would not. This brings us to the view that if instruction in the sunk cost principle would lead a decision-maker to believe that abandoning an R&D project cannot result in a waste of resources already spent, then neither of the possible action forecasts will show the resources already spent as a waste. A quotation from a management accounting textbook that discusses the sunk cost principle supports this reasoning. Just after stating that sunk costs are irrelevant to the decision-making process, the textbook states: "All past cost are down the drain. Nothing can change what has already happened (Horngren *et al.*, 2007, p. 264)." The idea being that you cannot waste what you no longer have. This quotation might make a reader of the textbook realize that wasting resources already spent is a contradiction in terms, and therefore impossible. Drawing on the previous, the first path of moderation would look as follows:

> *First path of moderation*: instruction in the sunk cost principle moderates the sunk cost effect in R&D progress decision-making, *by preventing decision makers from using a contingent rule that states that abandoning an R&D project will result in a waste of resources already spent,*

which in turn, avoids the decision makers'"abandon project" action forecast incorporating a waste of resources already spent (The italic part is the alternative explanation that we can provide by looking through the lens of Figure 1.)

As an overview, Figure 3 shows both paths of moderation through which instruction in the sunk cost principle may moderate the sunk cost effect in R&D progress decision-making.

Discussion and conclusion

In this article, we have explored the ability of a new theory of decision-making, narrative-based decision theory (Beach, 2009a, b; Beach, 2010), to help explain the outcome of R&D progress decisions. We did so by interpreting a finding of existing empirical work, the finding that instruction in the sunk cost principle may mitigate the effect of sunk costs on R&D progress decisions (Harrison and Shanteau, 1993; Tan and Yates, 1995), in terms of narrative-based decision theory. First, by drawing on narrative-based decision theory, we derived a model of the cognitive process that takes place when a person makes an R&D progress decision. Subsequently, by integrating the process model and Larrick et al's explanation (1990) as to how instruction in the sunk cost principle may prevent the sunk cost effect from occurring, we developed a more detailed explanation of how instruction in the sunk cost principle may moderate the effect of sunk costs in R&D progress decision-making. In so doing, we shed light on two paths of moderation through which instruction in the sunk cost principle may moderate the sunk cost effect in R&D progress decision-making. More specifically, our approach has not only resulted in a more complete description of the path of moderation in which the normative rule studied by Larrick *et al.* (1990) is prevented from being used, but also resulted in an alternative path of moderation in which a contingent rule, that may be of equal importance in the creation of the sunk cost effect, is prevented from being used.

The contribution of our article stems from our use of a novel process model of how people choose between two alternative courses, a model that can be derived from narrative-based decision theory. The article demonstrates that the process model can help explain how, in the case of R&D progress decisions, a predictor variable – sunk costs – and an accompanying moderator variable – instruction in the sunk cost principle – may exert an influence. Thereby, the article raises the question whether narrative-based decision theory may also be able to help elucidate the causal mechanisms underlying other relationships observed in research on R&D progress decisions. One could for example explore whether narrative-based decision theory, as a theoretical lens, can also bring clarity to how other predictor variables are related to the outcome of R&D progress decisions; or how the relationships between such predictor variables and the outcome of R&D progress decisions are affected by moderator variables. Such an investigation could, like ours did, start with the question whether the predictor or moderator variable might be affecting decision-makers' current narratives, contemplated actions, contingent or non-contingent rules, or normative rules. Overall, based on the result of our exploration, we call for further investigations into narrative-based decision theory's value in understanding R&D progress decisions and other management decisions.

Another, more practice-oriented, opportunity for future research would be to investigate whether narrative-based decision theory, as a theoretical lens, can help in improving the quality of R&D progress decisions. As a first step, one could for example try to help decision-makers make explicit their reasoning when considering whether to allocate additional resources to an R&D project. Following the logic of the process model from Figure 1, this would include portraying an decision-maker's action forecast for each contemplated action, the normative rules used, the contingent and non-contingent rules used, and the accompanying current narrative. A second step would then, for example, be to help improve the decision-maker's reasoning by asking questions about the portrait of the decision-maker's reasoning; questions that, following the logic of narrative-based decision theory, seem to be relevant for assessing the quality of choices between alternative courses of action. In this second step, already existing decision aids serve as source from which helpful questions may be derived (Kahneman and Tversky, 1977; Butler, 1985; Beach, 2009b; Kahneman *et al.*, 2011). Furthermore, besides trying to help decision makers by using narrative-based decision theory as a lens to detect helpful questions, one could investigate whether narrative-based decision theory can be used as a lens to improve existing computer-based decision support systems.

To conclude, by introducing narrative-based decision theory's view of how people choose between alternative courses of action to management researchers, and by subsequently exploring its value in understanding R&D progress decisions, we hope to contribute to a more in-depth understanding of R&D progress decisions and other management decisions. This, in turn, we hope will help those who make such decisions.

Notes

1. In the 2009 publications, the theory was referred to as Narrative-Based Decision Theory. However, in the book published in 2010, the theory was extended with a new view on the relationship between narrative and paradigmatic thought. The overall theory was named the Theory of Narrative Thought.
2. In real-world settings, the process that leads to such a choice may vary, and the choice may include more than the two options mentioned previously. However, for reasons of simplification, we confine ourselves in this article to the process of choosing between the two options that are also used in the Radar-Blank Plane experiments on the sunk cost effect in R&D progress decision-making.
3. Since our primary focus is on the substantive significance, we first report the effect size (measured by Pearson's r), and then report on the statistical significance (measured by χ^2 or F, and p). To calculate effect sizes we have followed instructions from Field and Wright (2006).

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Appendix

Here we provide an overview of the magnitude of the sunk cost effect, i.e. the effect size, as observed in Radar-Blank Plane experiments. Table AI provides a summary of the observed

Radar-Blank Plane experiment	N	r
Experiment one from the Conlon and Garland (1993) paper		
Contrast between no sunk costs condition and $ 1 million condition[a]	about 290	$-1 < r < 0$
Contrast between no sunk costs condition and $ 5 million condition[a]	about 290	$0 < r < 1$
Contrast between no sunk costs condition and $ 9 million condition[a]	about 290	$-1 < r < 0$
Contrast between no sunk costs condition and $ 1 million condition[b]	about 290	$-1 < r < 0$
Contrast between no sunk costs condition and $ 5 million condition[b]	about 290	$-1 < r < 0$
Contrast between no sunk costs condition and $ 9 million condition[b]	about 290	$0 < r < 1$
First two experiments from the Tan and Yates (1995) paper		
Contrast between no sunk costs condition and $ 7 million condition[c]	41	0.08
Contrast between no sunk costs condition and $ 7 million condition[c]	50	0.59
Second two experiments from the Tan and Yates (1995) paper		
Contrast between no sunk costs condition and $ 7 million condition[c]	48	0.13
Contrast between no sunk costs condition and $ 7 million condition[c]	50	0.16
Experiment from the Moon (2001a) paper		
Contrast between no sunk costs condition and $ 1 million condition[a]	177	0.01
Contrast between no sunk costs condition and $ 5 million condition[a]	173	0.04
Contrast between no sunk costs condition and $ 9 million condition[a]	176	0.20
Experiment one from the Van Dijk and Zeelenberg (2003) paper		
Contrast between no sunk costs condition and Fl. 0.5 million condition[d]	62	0.35
Contrast between no sunk costs condition and Fl. 1.5 million condition[d]	62	0.42
Contrast between no sunk costs condition and ambiguous sunk costs condition[d]	62	0.04

Notes: Only Radar-Blank Plane experiments that did not confound sunk costs with project completion are listed. [a]Dependent variable: likelihood of allocating the next 1 million from the budget to continue the project. [b]Dependent variable: likelihood of allocating all the money remaining in the budget to complete the project. [c]Dependent variable: allocation of 3 million to complete the project. [d]Dependent variable: allocation of 1 million to launch the new product

Table AI. Magnitude of observed sunk cost effect in Radar-Blank Plane experiments in terms of Pearson *r*; contrast between no sunk costs condition and sunk costs conditions

Table AII.
Magnitude of observed sunk cost effect in Radar-Blank Plane experiments in terms of Pearson *r*; contrast between sunk costs conditions "half or 1 million" and sunk costs conditions " > 1 million"

Radar-Blank Plane experiment	*n*	*r*
Experiment one from the Conlon and Garland (1993) paper		
Contrast between \$ 1 million condition and \$ 5 million condition[a]	about 291	$0 < r < 1$
Contrast between \$ 1 million condition and \$ 9 million condition[a]	about 291	$0 < r < 1$
Contrast between \$ 1 million condition and \$ 5 million condition[b]	about 291	$0 < r < 1$
Contrast between \$ 1 million condition and \$ 9 million condition[b]	about 291	$0 < r < 1$
Experiment two from the Conlon and Garland (1993) paper		
Contrast between \$ 1 million condition and \$ 9 million condition[a]	262	$-1 < r < 0$
Experiment two from the Garland and Conlon (1998) paper		
Contrast between \$ 1 million condition and \$ 9 million condition[a]	69	−0.45
Experiment three from the Garland and Conlon (1998) paper		
Contrast between \$ 1 million condition and \$ 9 million condition[a]	32	0.27
Experiment from the Moon (2001a) paper		
Contrast between \$ 1 million condition and \$ 5 million condition[a]	164	0.03
Contrast between \$ 1 million condition and \$ 9 million condition[a]	167	0.19
Experiment one from the Van Dijk and Zeelenberg (2003) paper		
Contrast between Fl. 0.5 million condition and Fl. 1.5 million condition[c]	62	0.02

Notes: Only Radar-Blank Plane experiments that did not confound sunk costs with project completion are listed. [a]Dependent variable: likelihood of allocating the next 1 million from the budget to continue the project. [b]Dependent variable: likelihood of allocating all the money remaining in the budget to complete the project. [c]Dependent variable: allocation of 1 million to launch the new product

effect sizes, in terms of Pearson's *r*, for the contrast between no sunk costs condition and sunk cost conditions. Table AII provides a summary of the observed effect sizes, in terms of Pearson's *r*, for the contrast between sunk costs conditions of half or 1 million and sunk costs conditions of more than 1 million. If the effect size was not reported in the original article, we extracted it from the original article if we were able to do so by using instructions provided by Field and Wright (2006) and Rosenthal and DiMatteo (2001). If the original article did not include sufficient data to extract effect sizes, we contacted the authors for the raw data.

Consistent with the sunk cost results of a recent meta-analysis of the determinants of escalation of commitment (Sleesman et al., n.d., in press), Tables AI and AII show that the effect sizes as observed in Radar-Blank Plane experiments differ across experiments. This is in line with the notion that effect sizes should be heterogeneous across studies in the vast majority of cases (Field and Gillet, 2010).

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