

## **Irrational Perseverant or Unrecoverable Optimist?**

### **A Normative Reading of Sunk Cost Affected Behaviors**

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## ABSTRACT

The purpose of this study was to analyze the relationship between the sunk cost effect and ambiguity in investment situations. Starting from the sensemaking approach and the decision dilemma theory, our hypothesis is that a sunk cost affected decision can be “constructively” rational in ambiguous environments in the sense that decision makers have the opportunity, through actions, to enact an environment that allows an effective utilization of their sunk costs. We called this attitude “constructive rationality”. We conducted an experiment (N=353) in which we manipulated the degree of ambiguity of the typical investment scenario proposed in the seminal work of Arkes and Blumer (n. 3A), analyzed the willingness to continue in each scenario, and the driving forces behind positive responses. Our results demonstrate that ambiguity favors further commitment of resources allowing a constructive interpretation of the future. Implications of these results and directions for future research are discussed.

**KEYWORDS:** sunk cost; escalation of commitment; ambiguity; retrospective rationality; sensemaking; enactment; constructive rationality.

## Irrational Perseverant or Unrecoverable Optimist?

### A Normative Reading of Sunk Cost Affected Behaviors

Classic rational choice theory states that decision makers, when deciding, should choose among a set of alternative courses of action in order to reach goals that are ranked according to a well defined evaluation criterion. In this sense, courses of action must be consistent to the decision maker's objectives and preferences and, moreover, such consistency must be directed from preferences to actions (Katz & Rosen, 1994). According to this traditional model, the primacy of preferences leads them to be considered as an exogenous and *a-priori* independent variable. For instance, in economic decision making theories, the criterion used to judge consequences has to be consistent with the so called subjective expected utility (SEU) function that evaluates each consequence on the basis of its incremental cost and benefit.

A major corollary of this view implies that unrecoverable past investments should not be considered in the decision process since their marginal cost is null. As clearly said by Johnstone (2003, p. 209): "For decision-making purposes, sunk costs are strictly irrelevant. This is a law of economic logic justified by the argument that because no action (current or future) can avert or reduce a sunk cost, no sunk cost can be attributed to or have any relevance to current or future action". As a consequence "By definition, any sunk cost related to some course of action is a constant, whether or not one chooses to continue the action" (Garland & Newport, 1991, p. 56). Past is past, and it can no longer influence the desirability of future consequences (Wang & Zang, 2001).

While during the last decades this paradigm has been proposed and accepted as normatively correct, a series of experiments confirm that when decision makers should decide whether to continue investing in an ongoing project, they are heavily influenced by the

amount of “time, money or effort already spent” (Arkes & Blumer, 1985, p. 124). Such influence is twofold. On the one hand, when decision makers evaluate the net benefit of different alternatives, they tend to consider past unrecoverable costs associated to each as a factor that lowers the utility of the other alternatives. That is, “...paying for the right to use a good will increase the rate at which the good will be utilized *ceteris paribus*. This hypothesis will be referred to as the *sunk cost effect*.” (Thaler, 1994, p. 11). A typical example is the one proposed by Arkes and Blumer (1985) in which respondents have to choose between two different holydays they already paid for (and that are not refundable) since they are told that the two trips occur in the same period; typically, respondents tend to choose the trip that displays a greater sunk cost even if the other behavior is more desirable.

On the other hand, it has been demonstrated that sunk costs do not limit their effect to the retrospective evaluation of net utility; they also constraint future actions in the sense that decision makers will tend to invest additional resources in the initiated investment i.e. they tend to “throw good money after bad money” (Garland, 1990). A typical experiment, widely analyzed in this work, proposes to decision makers an investment project that, once reached 90% of budgeted expenditures, faces a negative feedback signaling, from the perspective of researchers, a failing course of action. Nonetheless, the majority of respondents commit the remaining budget to such evident failure.

In sum, as we can see from figure 1, sunk costs seem to both retrospectively constraint the evaluation of costs and benefits (sunk cost effect), and prospectively, generate additional commitments to the failing course of action (irrational escalation) (Staw, 1976). From the perspective of the classic decision theory, both behaviors are to be considered as irrational (a maladaptive economic behavior) because they do not evaluate consequences of alternatives only considering future benefits and costs (Katz & Rosen, 1994). That is, their behavior is retrospective and, thus, not consistent to the normative prospective model (Conlon & McLean

Parks, 1987). Scholars of such irrational reading use psychological hypotheses to explain why decision makers find so hard to “extract themselves from losing situations” (Moon, 2001, p. 104). For instance, the most known arguments are the “don’t waste” rule (Arkes & Blumer, 1985; Arkes, 1996), the self-justification explanation (Staw, 1981; Staw & Ross 1989; Brockner, 1992) the prospect theory effect (Kahneman & Tversky, 1979; White, 1986), the project completion (Garland & Conlon, 1998), and the mental accounting explanation (Thaler, 1985).

Other schools of thought take a different position in respect to the presumed irrationality of such behaviors. These authors question the generality of empirical studies due to the fact that subjects were not provided with estimations of future returns and/or alternatives (Conlon & McLean Parks, 1987; Tan & Yates, 1995; Heat, 1995). In general, they are more prudent in stating that in real decision contexts a “past looking” attitude can be judged as a wrong decision strategy. For some, when facing a negative feedback, the lack of information or clarity about past trends pushes the decision maker to an “attendant” approach in order to gather additional information, have a proper framing of the decision and avoid mistakes (McCain, 1986; Northcraft & Neale, 1986; Chi & Nystrom, 1995; Singer & Singer, 1986). Similarly, for others, an additional marginal investment is a way to stimulate an environmental reaction and gather more feedback about the current course of action. From this perspective “...delaying exit decisions under equivocal conditions is not necessarily erroneous; it may be the case that investors are waiting to gather more information about the situation” (Hantula & DeNicolis Bragger, 1999, p. 437). Others stress the abstractness of the decision context proposed in the experiments since questions are typically of a “one shot” type: respondents have to decide basing their decision on a one step historical evidence; that is, the current negative feedback. On the contrary, these researchers sustain that a more extended historical cue enables more “prospective” evaluations (Goltz, 1992, 1993;

Drummond, 1998; O'Flaherty & Komaki, 1992). In general those critics do not disagree with the fundamental assumption underlying the sunk cost theory but rather with the validity of the experimental evidences. That is, decision makers should be normatively prospective, while retrospection is a comprehensible sub-optimal strategy in situations characterized by uncertainty (where information about the decision context is lacking).

Another school of thought in this area that falls under the notion of decision dilemma theory, proposes a critic from a quite different point of view (Bowen, 1987; Hantula, 1992; Nortcraft & Wolf 1984; Hantula & DeNicolis Bragger, 1999). Their contribution opens sunk costs studies to the wider research inquiry on sensemaking and organizational epistemology, throwing a constructivist light onto these supposedly irrational behaviors. Such works imply a critic that goes at the very heart of the positivistic epistemological assumptions inherited by the sunk cost theory from the classic decision making paradigm (Drummond, 1998). In addition, they criticize the assumption by which the normative rational model must be prospective while proposing retrospective reasoning as a quite correct decision criterion when the actor is facing particular environmental situations. In particular Bowen commented that “because equivocal decision situations often lack generally acceptable decision criteria, and because of the nature of enactments in organizations, choice of strategy depends upon ... the definition of the problem ... as well as the outcome(s) of prior strategies”. (1987, p. 58). More precisely, this school of thought underlined not only that previous experiments made to evaluate such irrationality were characterized by a strong degree of ambiguity; rather, they affirmed that this characteristic doesn't allow a classic prospective decision making process, and thus participants cannot be considered irrational.

Starting from these considerations, our work is focused on the notion of ambiguity and its influence on decision situations. In fact, as we propose, the rationality of a course of action in ambiguous situations is heavily dependant from the decision maker's commitment in

pursuing his beliefs and his ability to enact a favorable environment. This means that, for the decision maker, ambiguity represents the opportunity for a favorable interpretation of the decision context and, consequently, for committing himself to the construction of an environment consistent to such belief. Borrowing this alternative approach to rationality from the critics to decisions of March (1997, 1999), and the sensemaking approach of Weick (1979, 1995), our hypothesis is that, in ambiguous situations, sunk cost affected evaluations represent a way to hypothesize a “possible world” consistent to the only certain “thing” the decider can handle to: past decisions. Moreover, we propose that escalating commitment represents a way for the decision maker to commit himself to the “construction” of such possible world. As a matter of fact, we propose that sunk cost affected decisions cannot be normatively defined as irrational in ambiguous environments. On the other hand we agree with those that define retrospective reasoning as a proper form of rationality in which consistency between actions and preferences is maintained, but the direction of such relation is inverted; that is, preferences may normatively adapt to actions.

### Ambiguous Decision Contexts

Ambiguous situations are those in which there is a lack of meaning since there is no sufficient information in order to formulate a unique frame according to which events can be interpreted and probabilities formulated (Cohen, March & Olsen, 1972; March & Olsen, 1976; Hatch, 1997). As a consequence, a decision maker can formulate alternative and even conflicting frames and, according to these, information can be interpreted in different and plausible ways (Gioia & Chittipetti, 1991). For instance, if there is either an impossibility to establish a unique judgment standard to compare consequences, or cause-effect relationships are not so clear, different interpretations of the data are then available (Levine 1985; Martin,

1992). In this case, the consideration of an alternative and a consequence as “bad” or “good” depends on the adopted interpretation frame. Indeed, if facts and feedbacks can be read in different ways, there is no rational choice implied by the characteristics of the situation since these are compatible with more and even conflicting options. As a consequence, an apparently clear situation (from an *a-posteriori* and external perspective) can display *a-priori* more than one possible interpretation and, therefore, more than a single future scenario can be pursued.

It is important to highlight that ambiguity can be intended according to two different epistemological and ontological views. As said by Weick (1995, p. 95): “Although the word ambiguity also means the presence of two or more interpretations, it can also mean something quite different, namely, a lack of clarity, which makes it quite similar to uncertainty”. On the one hand, it can be intended as a form of ignorance of the decision maker, which is unable to formulate a clear frame of reference. In such sense, ambiguity is similar to uncertainty, because it refers to a subjective lack of information. More precisely, is a form of uncertainty about the probability function, that is, “Ambiguity is uncertainty about probability, created by missing information that is relevant and could be known.” (Camerer & Weber, 1992, p. 330). This notion of ambiguity is clarified by the well known Ellsberg urn problem (Ellsberg, 1961), in which “the information about the contents of the urns in principle exists; it is just not made available to the decision-maker. It is hidden information, rather than nonexistent at the moment of the decision.” (Dequech, 2000, p. 46). We will refer to this notion as to the one of “subjective ambiguity” since is caused by the decision maker’s cognitive limitations. In epistemological terms, still a correct frame of reference is “written” in the decision context but the actor is unable to perceive it properly. As a consequence, in order to generate a correct decision, the actor should collect more information.

On the other hand, ambiguity can be intended as an objective limitation, in the sense that the environment is ontologically underspecified, and thus can be constructed according to alternative multiple interpretations<sup>1</sup>. Borrowing from Berger and Luckman's constructivism (1966), and Giddens's structuration theory (1984), the actor is both a product and a producer of reality i.e. the environment constraints the agent's behaviors while these are able to shape environmental constraints. Moreover, since the structure is somehow "malleable", meaning can be created through its manipulation. From this perspective, ambiguity qualifies situations in which there are multiple plausible readings of the same context in the sense that each reading can implement, through action, such possible configuration. In economic theory, this kind of malleable environment has been qualified as "transmutable" (Davidson, 1996) while the related notion of ambiguity has also been called fundamental uncertainty (Dequech 2000, p 48):

"These situations are essentially characterized by the possibility of creativity and structural change and therefore by significant indeterminacy of the future. Uncertainty appears here in a dynamic context, in which the passage of time is crucial. The future cannot be anticipated by a fully reliable probabilistic estimate because the future is yet to be created. In socioeconomic contexts, the future is to a considerable extent unknowable, because surprises may occur, both as intended and as unintended consequences of human action. The very decisions that would require a fully reliable probabilistic guide may change the socioeconomic future in an unpredictable way, and this possibility of change prevents such a fully reliable guide from existing."

In epistemological terms, such type of ambiguous situations are those in which knowing alternatives is neither a passive acquisition of information about reality (description), nor an idealistic production of structure (prescription), but rather an ongoing

interaction between the agent and the environment. From this perspective, action is a means to know, in the sense that through action the agent produces reality and, in turn, knowledge. In ontological terms, there is not an *a-priori* correct interpretation of the world but rather a continuous accomplishment of a possible coupling between a decision maker and a decisional context. We will refer to this notion as to the one of “objective ambiguity” which presumes that the environment is “malleable” and thus compatible, *ex-post*, with alternative and even conflicting interpretations.

### Effects of Ambiguity on Decision Making: The Sensemaking Process

Since in ambiguous environments a clear interpretative frame does not exist, decisions under ambiguity can be seen as doubled faced processes of interpretation (the subjective formulation of a frame such as an evaluation criterion) and consequent selection of an alternative (choosing a course of action) (Weick, 2000). Moreover, ambiguity presumes that successful decisions are those that, because of interpretative framing and committed actions, were able to shape a favorable decision context: “ambiguity understood as confusion created by multiple meanings calls for social construction and invention.” (Weick, 1995, p. 95). As said by Macquarrie (1972, p.75) “We do not choose an antecedent good, but make something good by choosing it”. In this sense, while a decision under subjective ambiguity can be ideally judged, *a-priori*, as right or wrong since a correct interpretation is ideally available, in objective ambiguity decisions can be judged only *ex-post*. In these cases, as pointed by Weick, ambiguity cannot be solved through the acquisition of additional information since “people are unsure what question to ask and whether there even exists a problem they have to solve” (1995, p. 99). The same author proposes that a possible way to face and reduce ambiguity in decision-making is through the sensemaking process. In his words (1995, p. 99):

“To talk about sensemaking is to talk about reality as an ongoing accomplishment that takes form when people make retrospective sense of the situations in which they find themselves. There is a strong reflexive quality to the process. People make sense of things by seeing a world on which they have already imposed what they believe.”

The starting assumption is that rationality, rather than being a process aimed at keeping consequences coherent to preferences is more weakly oriented towards keeping coherency between consequences and preferences either adapting the former to the latter or the opposite. On this regards, the concept of rationality is the one proposed by March of appropriateness; human actors are aimed at matching identities (expressed, for example, by preferences) and situations (such as decisional contexts), either modifying their identities or the situation they face (March, 1994). Similarly, Weick proposes that “People can cope with change in one of two ways. They can adapt to the change by weakening their commitment and changing their actions, or they can manipulate the change by reaffirming their commitments and strengthening their actions” (1995, p. 161). That is, when people face situations that interrupt the normal flow of significance (a fact that generates a cognitive dissonance between expected and manifested consequences (Festinger, 1957)), they need to re-establish appropriateness between their identities (preferences) and situations (consequences) manipulating either what they believe in, or what they see. In such sense, the concept of sensemaking contains two main logical moments as can be seen in figure 2: the retrospective process of interpretation (sense) and prospective one of enacting a new configuration of the environment (making).

The first logical moment (the “sense” phase) implies that, before taking action in order to re-establish a correct environment, agents try to give a sense to what they have done seeking for plausible reasons and motivations. Such process needs to handle to some fixed element; as proposed by Weick, this handle is provided by the past. Through the observation

of the past, subjects can give an order to current events to assign them significance and, therefore, what decision makers see is heavily influenced by what they have previously done.

However, the very importance of the sensemaking process goes beyond the simple clarification of a situation. In fact, it influences what and how data is to be considered and judged by the subject in order to implement future actions (Choo, 2002). In this sense, Weick proposes the concept of enactment to describe the way an agent alters and changes its environment through committed action. In particular:

“...sense making is an active process. I say this because of the ease with which the phenomenon of sense making slides into other phenomena such as cognition, perception, and representation. The problem is that many of the images associated with these related phenomena are passive and imply accepting the environment as given...This passivity may make some sense if one thinks like a realist and views sensemaking as a problem of discovery. But if one thinks like a constructivist, and sees sensemaking as a problem of invention, then the inventor has to do something more than ponder what is there (Fondas & Stewart, 1994). The inventor has to put something there, or consolidate what is there, or poke around to see what might be there, or orchestrate some kind of agreement about what is there. All of this placing, consolidating, poking, and recruiting is action in the world. This action affects what the organization then sees” (1995, p. 162).

The enactment phase implies that, once an interpretation is formulated, decision makers are able to enact an environment favorable to such interpretation. In epistemological terms, once a decision maker has chosen an interpretative frame, he can influence and manipulate the environment (the reality) in order to establish, *a-posteriori*, the truth conditions of his beliefs (i.e. the so called self fulfilled prophecy). In fact, “once people choose how to justify the action that they choose to perform, they fix the frame within which their beliefs, actions

and associations will then make sense" (Weick p. 164). From this perspective, commitment, rather than an obstacle in taking rational decisions, "focuses the social construction of reality on those actions that are high in choice, visibility and irrevocability... the meaning of the action thus becomes whatever justifications survive this editing process and become attached to the action" (p. 162).

### Ambiguity, Sensemaking and Sunk Costs

As said, ambiguous situations are those that are compatible with alternative interpretations of the future. Moreover, we assumed that rationality, in the sense proposed by March, aims at keeping coherency between what the agent is (the identity) and what the environment requires him to be (the situation). On the other hand, both Weick and March underline how the identity of the agent is fundamentally rooted in the past; that is, the agent's identity is built around what the agent did (his decisions) and, moreover, what the agent can do (the capabilities that he acquired through his decisions<sup>2</sup>) (Wenger, 1998). For example, an agent that profuse an effort in order to obtain a taxi license, will build his identity around that decision and, moreover, around his capability to drive a taxi. What here needs to be emphasized is that such retrospective process of identity construction as a justification of past decisions will consider, more seemingly, those past decisions characterized by some degree of irreversibility. That is, the more a decision produces irreversible effects, the more the agent has a reason to build his identity around such decision; as said, such possibility is ensured by ambiguity since the future is compatible with different identities. On the contrary, both if the future is not ambiguous and decisions are reversible, than the agent will have no reason to build his identity around the past since a given world will tell him what he should be and each decision can be instantly reformulated. In this sense, justifications generated by means of

sensemaking will not be draped around any past decision, but rather around those decisions that display some degree of irreversibility (the action cannot be undone). Said differently, when producing some sense of an ambiguous world the agent will do so adopting, as a handle, past irreversibilities. In fact, as noted by Kiesler (1971), “once a behavior is frozen, cognition in the form of justification is draped around”. Such statement offers an intriguing link among the sensemaking theory and studies on the sunk cost effect. As a matter of fact, the latter provides an economic reading to the former since it systematically studies how past irreversibilities influence current interpretations. On the other hand, the former provides, as we propose in this article, a less reductionist perspective in order to explain why people are so frequently influenced by the past.

In this work, we propose to read sunk cost affected reasoning as the economic counterpart of the sensemaking process. In particular, from the perspective of the “sensing” process, it seems reasonable on the one hand to view sunk costs as the “handle” to which actors can refer to when making sense of decisional contexts, while, on the other, to read sunk cost affected reasoning as the economic dimension that motivates the cognitive retrospective sensemaking process. In short, if alternative interpretations can be formulated, is not unreasonable to formulate the most convenient one; that is, an interpretation that provides a reason to reuse irreversible past investments.

From the perspective of the “making” process, if we transpose such concepts to the sunk cost theory, commitment of additional resources can be seen as the way in which actors tend to actively shape their decisional context, and the so called irrational escalation provides an economic motivation to the cognitive process through which decision makers bound themselves to such construction. In this sense, as clearly stated by Bowen (1987, p. 58):

“...decision makers will continue to invest in courses of action beyond the point where others, having enacted a different reality with possibly different decision standards,

believe prudent. It is also understandable that resources may be reinvested in a course of action, assuming some degree of commitment to that course of action, because of the equivocality inherent in the situation and not because of an over-commitment to a failed investment”.

In sum, we propose that, when facing ambiguity, decision makers will implement a double faced cognitive strategy motivated by, symmetrically, a double faced economic evaluation driven by “irreversibilities”: at first, they adopt a sunk cost affected reasoning mode in order to generate a plausible interpretation of the decisional context (sense phase), and, in a second moment, they escalate their commitment in order to enact consequences consistent to such evaluation (making phase). That is, they seek for a convenient explanation of their current irreversibilities and, consequently, commit additional irreversibilities in order to “fix” such explanation in the world. As we will see afterwards, we call this attitude as “constructive rationality”. Figure 3 shows the strong relationship we envision between sunk cost affected behaviors and the sensemaking approach. As a corollary, the more a situation is ambiguous (and has a degree of manipulability) the more a decision maker has the “opportunity” to implement such double faced strategy. That is why we expect, as showed in our experiments, that the higher the ambiguity of the decisional context, the more people will escalate and, on the contrary, non ambiguous situations will lead, from a classic perspective, to perfectly rational choices. In the next paragraph we provide some experimental data in order to sustain such argument.

## The Experiment

As said in the introduction, previous researches on the sunk cost effect were made to demonstrate that investments in money, effort or time influence decisions in a negative manner. In order to reject this evaluation we made an investigation to validate the argument by which decision makers are influenced by sunk costs because of the ambiguity intrinsic to the decision context rather than because they are irrational. In this sense, we produced five decision making scenarios characterized by increasing levels of ambiguity i.e. displaying situation contexts that are increasingly readable according to different interpretative frames.

### *Main Hypothesis*

Our research hypothesis is that, in decision situations where a negative feedback (a dissonance) occurs, decision makers will be willing to invest additional resources (they would escalate) the more a situation enables higher margins to reinterpret the feedback in a way that is consistent with the reuse of past investments. On the contrary, when interpretative spaces are reduced, people tend to be rational in the traditional sense, that is, they tend to choose considering only future costs and benefits. Consequently, we expect that in non ambiguous situations the negative feedback will not imply the commitment of additional resources (decision makers will not escalate).

### *Main Assumption*

In order to measure the level of ambiguity of a decision context, we assumed that a situation is ambiguous the more it can be read according to different interpretative frames. That is, the more a decision context is compatible with alternative future scenarios, the more is ambiguous. Such assumption is coherent with the theoretical perspective here adopted, i.e.

the sense making approach. More in detail, each scenario was judged more or less ambiguous if respondents that continued motivated persistence referring to configurations of the future that were both different from the one implied by the negative feedback, and compatible with the reutilization of the sunk cost. In this sense, examples of qualitative responses given by students were: “I can shift the use of the investment for other purposes such as ...” or “I have the opportunity to emphasize other important characteristics of the investment rather than only those presented in the question”. A scenario was judged less ambiguous if those who decided to continue motivated persistence on the base of merely retrospective arguments. Examples in this sense were: “I have already spent a lot of money”, “It is a waste to stop the investment since it is almost finished”, “I bet my face on the investment”.

### *Evaluation of the Responses*

According to the above assumption we first formulated different decision scenarios that were intuitively characterized by an increasing level of interpretability. Afterwards, in order to test such graduation and analyze the driving force behind the willingness to continue, we measured the level of ambiguity using the qualitative responses provided by students. In particular:

- the more respondents motivated the continuation because they envisioned at least a future scenario in which they could correctly reuse their past investment, the more we considered the question and thus the scenario as ambiguous. Furthermore, we classified these kind of respondents as constructively rational (CR), since continuation was motivated by a manipulative commitment to expect or enact a favorable future state of the world;

- on the contrary, the more respondents motivated continuation on the base of purely retrospective motivations, the more the scenario was considered less ambiguous. In addition, these kind of respondents were considered as irrational (IRR) since their responses were motivated on the base of merely retrospective motivations (e.g. don't waste rule, justification, mental accounting, etc.).

### *Materials*

In order to analyze the “element” ambiguity we intuitively altered the same decision schema according to five different investment scenarios characterized by increasing levels of interpretability. As schema, we adopted the well-known question n. 3A proposed by Arkes e Blumer (1985):

“As the president of an airline company, you have invested 10 million dollars of the company's money into a research project. The purpose was to develop a plane that would not be detected by conventional radar, in other words, a radar-blank plane. When the project is 90% completed, another firm begins marketing a plane that cannot be detected by radar. Also, it is apparent that their plane is much faster and far more economical than the plane your company could build. The question is: should you invest the last 10% of the research funds to finish your radar-blank plane?”

Starting from this question, we kept unchanged the four elements unanimously believed to be the facilitating factors in enabling sunk cost influenced decisions (Staw, 1997; Hantula & DeNicolis Bragger, 1999). These elements are as follows:

- *Investment concluded for the 90% of the budget.* This characteristic is considered fundamental in influencing current decisions. It represents the sunk cost and, at the same time, the completion of the investment.
- *Presence of negative feedback* (a cognitive dissonance that disturbs the decision maker view of the word). This characteristic is fundamental because it shows that the current course of action is evidently unable to achieve the desired goal state (past actions are going to fail). It should influence the decision maker's willingness to commit further resources to the undertaken course of action.
- *Personal responsibility of the decision maker.* This characteristic is considered strategic in influencing the decision maker to commit further resources in spite of negative results. Past experiments show that sunk cost effect is limited when a decision maker has no personal responsibility.
- *Opportunity to commit further resources to achieve the goal state.* This condition is clearly necessary to show the growth of the decision maker's commitment.

The four elements presented should define a situation in which, according to the traditional explanation, the sunk cost effect should uniformly influence decision-makers choices. That is, independently from the type of investment scenario, decision makers should be affected by sunk costs in a regular percentage. These factors appear unchanged in our new scenarios in order not to change the basic structure of the question. The five investment scenarios used are described below<sup>3</sup>:

- *Airplane:* in this scenario the sunk cost is considered an airplane project<sup>4</sup>. A similar but more efficient airplane that is going to be marketed by a concurrent company represents the negative feedback. The decision maker should consider himself the president of the company. Such scenario has also been used as the test case in order to verify the correctness of our experimental methodology. In this sense, we expected respondents to

answer according to a proportion similar to the one evidenced by Arkes and Blumer i.e. 85% of people will continue while the remaining 15% will stop.

- *Reclamation*: in this scenario the sunk cost is considered the 90% concluded reclaimed land that will host a car-park. The negative feedback is represented by the fact that the objective for which the reclamation was started (the construction of a Trade Centre), will not occur. As for the previous question, the decision maker should consider himself as the president of the company.
- *Medicine*: in this scenario the sunk cost is represented by the efforts used to develop a medicine useful to alleviate the symptoms of a disease. The negative effect is presented by the fact that a concurrent company is able to sale a cheaper medicine that will recover from the disease rather than just alleviate its symptoms.
- *Oil Excavation “150”*: in this scenario the sunk cost is represented by a drilled excavation to find oil. The negative feedback is represented by the fact that the newly methodology used to find the excavation point is judged wrong by an expert of the field. Due to the mistake made by the methodology, the correct excavation point is evaluated 150 km far from the current excavation location (with no certain direction).
- *Oil Excavation “500”*: this scenario is similar to the last. It differs only for the magnitude of the mistake generated by the methodology. Due to this mistake, the correct excavation point is evaluated 500 km far the current location (with no direction). Such scenario was also used to provide an additional evidence to our hypothesis expecting that to a quantitative increase of the measure of failure (500 km rather than 150) would correspond a quantitative de-escalation due to an increased difficulty, for respondents, to think about alternative future scenarios.

### *Participants*

Three hundred fifty three undergraduates of different faculties (Economics, Computer Science, Engineering and Cognitive Science) at a medium size University in Italy participated voluntarily in this study. Responses of two participants were excluded because their responses indicated that they did not understand the decision scenario.

### *Procedure*

Every participant was asked to respond to a randomly assigned question. After reading the scenario, subjects had to sign in a two-cell box whether they want to continue or stop the investment. In addition, students were also asked to motivate their decision with a qualitative response.

## Results

### *Description of the Responses*

Table 1 shows the results. According to our theoretical approach (i.e. the sense making theory), and our main assumption (i.e. constructive attitudes are correlated to ambiguity), we clustered the qualitative responses in two different categories in order to define constructive rational responses (CR) and classic irrational ones (IRR). In the scenarios *Reclamation* and *Airplane* almost all subjects decide to continue the investment. In fact, the 94% and 86% respectively are influenced by the sunk cost effect.

The analysis of qualitative responses is the following: the 94% of *Reclamation* that decide to continue, can be split in a 86,9% of people who decide to continue adducting a wide range of plausible scenarios in which to continue the investment is rational. For instance, in this scenario some qualitative response were: “The reclamation of a ground is usefully reusable for other functions” or “The fact that the Trade Centre will not be built any longer is not necessarily a trouble; in fact in the same place it can be built an hospital or something similar that needs a car-park”. The remaining 7,1% continue the investment adducting an irrational explanation.

In the *Airplane* scenario, the 86% of people that continue can be split in a 75,4% of individuals that continue due to rational responses. In fact, some interesting qualitative responses about this scenario were: “I can propose my airplane highlighting its better invisibility and giving less importance to the velocity and economical quality as essential features.” or “Having more information about the concurrent airplane I can use the remaining 10% of the budget in a way that better differentiates my airplane.”. 10,5% are considered irrational since they simply decided to finish the investment using an irrational explanation.

In the scenario *Medicine*, among the 60,8% of who decided to continue, the 52,6% uses a rational explanation (they want to differentiate the product, i.e. affirm that the investment is usefully reusable for other researches, or that that it is possible to improve and differentiate the product. For instance some interesting responses were: “I want to continue the investment because the medicine could be useful for other diseases” or “The research allows the opportunity to find other applications or results for our medicine”. 8,2% is considered irrational because those people simply decided to finish the investment motivating that they already spent resources in their course of action.

The last two scenarios, *Archeological Excavation 500 and Oil Excavation 500*, show the greater portion of subjects that decide to stop the investment. In fact who decide to

continue was respectively the 37,8% and the 29,4%. Of these the 26,7% and the 19,1% respectively explain the choice with rational argumentations. The 11,1% and 10,3% respectively uses irrational argumentations. For example, some motivated continuation adducting “Maybe if I continue, I will find water”. Some other expects to find different important fuels like gas, some other, state “I can use the excavation for storing dangerous waste”.

### *Measuring Ambiguity*

In table 1 we show, for each decisional situation, the percentage of total positive responses, the percentage of students that continue because they envision some future scenario that is compatible with their past investments (CR), and the percentage of students that continued on the base of merely retrospective motivations (IRR). Decision scenarios are ranked from the question that displayed a higher percentage of CR to the one that displays a lower percentage. We underline that:

- different decision scenarios display relevant differences in terms of constructive rational attitudes,  $\chi^2 (1, N = 319) = 102,70; p < .001$ . Moreover, according to our assumption, the different scenarios are characterized by different levels of ambiguity.
- The percentage of students that display an irrational attitude (IRR) is constant and particularly low (*mean* = 9,5%; *sd* = 1,7%). The former aspect seems to confirm the traditional reading of sunk cost affected behaviors in the sense that, regardless the decision context, decision makers display a retrospective “bias”. On the other end, the latter aspect seems to question the relevance of such “bias” (see the discussion below).

### *Measuring Escalation*

Once we measured ambiguity adopting, as a parameter, a relevant differentiation of constructive rational (CR) attitudes, we tested our main hypotheses. That is, we expected that de-escalation is manifestly correlated to ambiguity in the sense that the more people escalate, the more there are chances to envision new plausible configurations of the decision context.

In figure 4 we show the percentage of people that escalate (i.e. continue the investment) assuming as ordering criterion the level of ambiguity (from more to less ambiguous) as defined above. Regarding the escalation effect, we propose two main considerations.

First, we observed that there is an evident de-escalation effect according to different decision scenarios. Considering the results of Arkes and Blumer experiment, approximately the 85% of decision makers should decide to continue the investment in all scenarios. Instead, it is possible to see from figure 4 that the results of our five scenarios display a dramatic difference in the levels of commitment. Notice how the test case value has closely the same value of Arkes and Blumer's experiment (the difference is only of 1%). Comparing the test case (*Airplane scenario*) with other scenarios and except for the *Reclamation* scenario where the tendency to invest was not significantly different,  $\chi^2(1, N=141) = 2,65$ ; n.s., we have that for the *Medicine* the sunk cost effect is evidently lower,  $\chi^2(1, N=154) = 10,83$ ;  $p < .01$ . Finally the sunk cost effect decreases markedly for *Oil Excavation 150*,  $\chi^2(1, N=102) = 25,57$ ;  $p < .001$  and *Oil Excavation 500*,  $\chi^2(1, N=125) = 40,10$ ;  $p < .001$ .

This point, alone, cannot be explained by those that sustain that escalation is a maladaptive behavior which is intrinsic to the decision maker rather than to the decision context. In this sense, escalating behaviors should have been constant, given that the features of an escalating situation as defined by Arkes and Blumer are respected, regardless the object of the investment (see the discussion). In fact, they are all facing a situation in which the past

actions used to achieve the initial goal are apparently going to fail and they were not informed about future earnings or instructed with sunk cost principles (Heat, 1995; Tan & Yates, 1995).

A second consideration is that the de-escalation curve is highly correlated to the level of ambiguity of the decision context in the sense proposed by the sensemaking approach, and according to the measurement method here adopted (see figure 5); there is a high correlation between positive responses and constructive rational explanations ( $\rho = 0,99$ ). On the contrary, it's weakly correlated to merely retrospective (irrational) attitudes ( $\rho = 0,26$ ). As a consequence, we observe how the majority of those that continue do so not because they had already invested (such as according to a “don't waste rule”) but rather because they envision the opportunity to pursue a different future scenario. In other words, they would propose a future that is different from the one implied in the original course of action, and, nonetheless, compatible with its maintenance. In doing so, we propose that continuation is, in general, reducible not to a presumed “irrationality” of the decision maker, but rather to a “constructive” attitude allowed by an ambiguous decision context. On the other hand, the more the degree of ambiguity decreases, the more the interpretation of the negative feedback is troublesome in the sense that the situation can be interpreted less easily in a positive way. In such cases, an increasing portion of respondents manifest a rational behavior in the traditional sense; that is, they don't consider the past in order to decide for the future.

#### *Discussion of the Experiment: Ambiguity and Escalation*

The major perspective on sunk cost states that escalation of commitment is a situation in which “losses have been suffered, where there is an opportunity to persist or withdraw, and where the consequences of these actions are uncertain” (Staw, 1997, p.192). Due to

psychological or material costs, subjects tend to become locked into behaviors that lead to “throw good money after bad money”. According to this view, a series of experiments have been done, and observed escalating behaviors have been judged as irrational; in fact, even in the face of failure, people choose to continue an ongoing project. Such judgment basically derives from the assumption that the decision context displays a unique and *a-priori* defined interpretative frame. As clearly said by these authors (Staw, 1997 for a review), respondents tend to continue even if past investment objectively should not influence the decision appearing in this sense evidently irrational.

In our experiments, we have shown that escalating behaviors cannot be reduced to an independent feature that characterizes decision makers' attitudes. Rather, the presence of escalation seems to be a function of the decisional context configuration. From this perspective, we have shown that by altering the object of investment and living unchanged the typical features of an escalating situation, the number of people that escalate pass from a 94% to a 29,4%. Nonetheless, a constant tendency to escalate ( $mean=9,5\%$ ,  $sd=1,7\%$ ) is here confirmed although its relevance is heavily reduced. We believe that these findings should lead to the conclusion that escalating behaviors cannot be merely explained adducting a generalized maladaptive behavior, but rather they must be motivated taking into account, as proposed by a series of researches (Staw & Fox, 1977; Armstrong, Coviello & Safranek, 1993; Drummond, 1994, 1996; Garland, Sandefur & Rogers, 1990), the particular configuration of the decision context. Although people display a tendency to escalate, such tendency doesn't seem to represent the major motivation.

In order to investigate such motivations, we have shown, coherently to what was proposed by Bowen (1987), that the presence of escalating behaviors is heavily correlated to the perceived ambiguity of the decision context. Adopting a sensemaking perspective (Weick, 2000), we assumed that ambiguous situations are those that are compatible with

alternative interpretative frames. As proposed by Weick and March, the more a situation is ambiguous, the more decision makers cannot rely on future costs and outcomes in order to take a rational decision. Rather, they have to look at the only certain information they have, the past, in order to find a “handle” able to provide some form of coherency. In escalating terms, in ambiguous situations the decision maker has the possibility to envision a future state of affairs which is favorable to his past course of action. From this perspective, we have shown that escalation is strongly correlated to perceived ambiguity since respondents that continued motivated persistence adducting the availability of alternative configurations of the future, being at least one of these consistent to their investment. As a consequence, previous experiments are to be considered as ambiguous since respondents were provided with a feedback that was not useful to clearly determine *a-priori* if investing additional resources would have been profitable or not (Heat, 1995; Northcraft & Wolf, 1984). This means that the results of those experiments do not show a presumed irrationality due to the sunk cost effect, but rather the wealth of meanings people can give to apparently simple situations.

Moreover, we have shown that in non ambiguous situations, the major part of respondents don't escalate while those that continue motivate persistence, for an increasing proportion, adducting traditionally irrational explanation. Said differently, the less a situation is ambiguous, the less in absolute terms people escalate while the more, in relative terms, they do so on the base of merely retrospective motivations (see figure 6). While the former observation confirms that ambiguity can be considered as the major motivation in order to explain escalating behaviors, the latter confirms that the constant tendency to escalate (observed above) is in effect a constant “bias” since motivated only by past looking arguments. That is, the de-escalation curve seems to be “translated”, for a constant, in favor of escalation, and such translation can be explained as an interpretative bias (see figure 7). Such argument is not coherent to Arkes and Blumer's explanation of escalating behaviors

since the fallacy in viewing the past (“retrospective fallacy”) is, according to our findings, a minor motivation to continue. Rather, is consistent to the Prospect Theory (Kahneman & Tversky, 1979) reading in which people, in loosing situations, tend to systematically overestimate the probability to recover from their losses.

### General Discussion: Irrational or Constructively Rational?

It's to be underlined that, according to a sensemaking approach, ambiguity can be referred to subjective computational limitations, but also to an objective configuration of the environment that can be shaped, through manipulative actions, according to alternative interpretations. In this sense the environment, rather than a given constant, is a malleable matter that can match different expectations. Such perspective provides an opportunity to propose some other considerations. First, an escalating behavior can be normatively seen as a rational decisional strategy in strong rather than in weak terms. In the latter sense, assuming ambiguity as ignorance, escalation is proposed as a sub optimal strategy aimed at acquiring additional information under uncertainty (McCain, 1986; Goltz, 1992); nonetheless, this perspective assumes that “there is”, in the environment, an optimal answer which cannot be known by the decision maker, but that can be known by an ideal *omniscient* external observer. This reading is consistent to a bounded rationality approach, in which actors, due to their limited computational capacity, generate decisional heuristics that minimize the need of information according to a criterion of satisfiability (Simon 1972, 1976). In this sense, looking at the past through Bayesian observations, such as in the experiments proposed by Goltz (1992) and formally demonstrated by O'Flaherty & Komaki (1992), is red as one of these possible heuristic strategies. Consequently, past looking strategies are seen as weakly rational since unable to produce optimal outcomes, but rather some consistency between

decisions and outcomes (or procedurally rational as proposed by Simon). In fact, the strong classic rational model would still envision an ideal decision strategy that, given a complete knowledge of the world, is able to achieve optimal decisions based on the evaluation of future costs and benefits (i.e. substantial rationality).

On the other hand, objective ambiguity would propose past looking attitudes as normatively correct in a strong sense since decision makers have the opportunity to enact an environment that can be consistent, *ex-post*, with their retrospective interpretations. Such type of rationality is here called “constructive rationality”; as such, it proposes that decision makers, when facing ambiguity, could normatively adopt a sunk cost affected decision making process that is aimed at producing a plausible interpretation of the situation and, afterwards, escalate their commitment in order to implement their view “in” the world. As said at the beginning, accordingly to the kind of rationality proposed by March, this perspective may suggest that preferences may rationally adapt to actions.

Moreover, the enacted environment can be also substantially optimal and, according to Weick, the possibility to achieve such optimality depends upon two conditions (Weick, 1995, 2000). The first pertains to the actor and refers to the extent to which he's committed to his interpretation; in these terms, commitment is an expression of the energy that he will put in order to enact it. The second pertains to the environment and refers to its malleability; in these terms, the more an environment is malleable, the more it can be enacted in a way that matches the actors' interpretations. According to this view, we can provide some interesting reinterpretation of past experiments' explanations of escalating behaviors. This list is not exhaustive and, of course, requires additional investigations:

- retrospective justification is seen as one moment of the sensemaking process; as we have shown, respondents provide both a retrospective motivation to continuance and a prospective formulation of a plausible future scenario. In this sense, self-justification is

not a symptom of fallacy (Brockner, 1992) but rather a “handle” in order to sustain commitment and produce some reformulation of the decisional context;

- the observation that commitment increases escalation is, from a sensemaking perspective, totally plausible. In fact, the more a decision maker is committed, the more he will express a manipulative energy aimed at enacting a proper environment. On the contrary, as it is also intuitive in real life, decision without commitment will be hardly successful;
- incremental investments as a means to gather additional information about the environment (McCain, 1986) can be red as an attempt of the decision maker to test how “malleable” is the decision context. That is, through incremental commitments, the actor tests how responsive is the environment to his stimulations;
- the escalation bias here observed, which is consistent to the Prospect Theory (Khaneman & Twersky, 1979), can be red as an overgeneralization of a “constructive rule” rather than a “don’t waste rule”. That is, if decision makers experience successful decisions based on sensemaking processes, they could over-estimate their constructive/manipulative capacity and tend to rely on retrospective evaluations.

Notice that one of the first research articles of the sunk cost effect, the article of Arkes and Blumer, gives a chance to reinforce our enactment interpretation. In fact, they concluded the article proposing this story (1985, p. 139):

“... one person who recognized it as an error was none other than Thomas A. Edison. In the 1880s Edison was not making much money on his great invention, the electric lamp. The problem was that his manufacturing plant was not operating at full capacity because he could not sell enough of his lamps. He then got the idea to boost his plant's production to full capacity and sell each extra lamp below its total cost of production. His associates thought this was an exceedingly poor idea, but Edison did it anyway. By increasing his plant's output, Edison would add only 2% to the cost of production while increasing

production 25%. Edison was able to do this because so much of the manufacturing cost was sunk cost. It would be present whether or not he manufactured more bulbs. Edison than sold the large number of extra lamps in Europe for much more than the small added manufacturing costs. Since production increases involved negligible new costs but substantial new income, Edison was wise to increase production. While Edison was able to place sunk costs in proper perspective in arriving at his decision, our research suggests that most of the rest of us find that very difficult to do.”

Interestingly, Arkes and Blumer conclusion presents the characteristics of the “retrospective fallacy” (Bowen & Power, 1993) since their analysis is based on the results appeared at the end of the entire story (it is obvious now that Edison was right, we all use electric lamps). The judgment given by Arkes and Blumer to the Edison's activity is obviously based on today's sin (consequences) rather than through the eyes of yesterday<sup>5</sup> (possible forecasts). In particular, the sentence “... Edison was able to place sunk costs in proper perspective in arriving at his decision” gives us the chance to have some doubts about the negative judgment given to the results of past sunk cost effect experiments and, in general, to the behaviors of people in ambiguous situations. Such critic is quite similar to the one proposed by Karl Weick to Merton's argument on retrospective fallacy. We believe that both perspectives position very effectively the issue of escalating behaviors in the proper frame; that is, a more general discussion around the nature of rationality which, in turn, is rooted in a fundamental epistemological debate around the constructive nature of knowledge. On the one hand, Robert Merton clearly represents the position of those that view escalation as irrational and, in turn, knowledge as a given matter; on the other, Karl Weick represents the position, here adopted, that envisions sunk costs affected behaviors as an expression of a

different form of rationality, and knowledge as a constructed matter. For this reason we live to their arguments the conclusion of our discussion.

Robert Merton (from Weick 95, p. 147):

“The self-fulfilling prophecy is, in the beginning, a false definition of the situation evoking a new behavior which makes the originally false conception come true. The specious validity of the self-fulfilling prophecy perpetuates a reign of error. For the prophet will cite the actual course of events as proof that he was right from the beginning. Such are the perversities of social logic”.

Karl Weick (1995, p. 147):

“What Merton has described is a means to create sense, although it looks to be inaccurate sense. But look again. When a self-fulfilling prophecy is said to begin with a “false definition”, the question arises, false in whose view? And relative to what goals? The definition is said to be a false rendering of “the” situation, as if there were only one way the situation could be read. Multiple realities and over-determination apparently have no place here. The evoking of a “new behavior” in response to the false prophecy alters the situation, but not simply with respect to the prophecy. ... Merton treats the original prophecy as if it had only one meaning, which is contrary to the more likely possibility that all prophecies represent “unfinished business” capable of different readings. The achieved validity is said to be “suspicious”, but in fact, one could argue validity is validity. If the situation has been altered, and if it is read in light of the original prophecy, then the reading is accurate, no matter how that accuracy was accomplished. What is unleashed is not so much a reign of error as a new set of organized cues that accuracy was accomplished. This may qualify as “perverse social logic.” But if a person goes through these motions and continues to interact with the target in natural situations, amid other

group members who see things differently and say so, then these sensemaking operations have reduced uncertainty and enabled people to construct meaning.”

### Conclusions

The question of whether the stories of sunk cost influenced behaviors are stories of “perseverant irrationality” or “unrecoverable optimism”, can find an answer if we view the “problem” of sunk cost affected reasoning from the enactment perspective, and thus consider ambiguity and constructability of the environment as an opportunity to establish an alternative form of rationality, here called “constructive rationality” (Ponte & Bonifacio, 2004). In particular, we refer to a reasoning process that roots in the past (sunk costs) a handle to produce sense of an ambiguous situation, and enacts an appropriate future through a manipulative form of commitment (escalation). Such reading has been theoretically proposed by Bowen but no experiment has been done in order to provide a clear cut in favor of such constructivist perspective; that is, ambiguity represents a decisional opportunity that normatively legitimates sunk cost affected behaviors. Our work aims both at proposing experimental data consistent to this view, and, moreover, at extending Bowen’s proposal making more clear how it engenders the economic foundation of an alternative and normative rational model.

In order to sustain our argument we did a set of initial experiments aimed at showing how, by altering the level of ambiguity of the decision context, escalation of commitment dramatically changes. Such change reaches a point in which the proportion between escalating (supposedly irrational) and non-escalating (supposedly rational) decision makers is inverted. Moreover, the variation of escalating behaviors is evidently correlated to the possibility for respondents to adopt a “constructive” rather than a merely retrospective

attitude. These preliminary results may not provide full evidence to our constructivist explanation of such inversion. Nonetheless we believe that they cannot be explained by the traditional sunk cost theories. In such terms, we propose on the one hand, our experiments as a strong, and hopefully conclusive, counter argument to the reductionism implied by the “irrational” school of thought and, on the other, our explanation as a plausible interpretation of a so common and often innovative decision attitude. Such attitude shows decision makers as creative thinkers rather than reactively adapting to a given destiny, able to get a success out of their failures rather than withdrawing when facing odds, and willing to overcome those impossibilities that are so often accepted by ordinary thinking and common sense. From this perspective, we prefer to view sunk cost affected reasoning as a symptom of a “constructive” form of rationality, or, said differently, as a manifestation of “unrecoverable optimism” rather than “perseverant irrationality”.

### *Open Issues and Future Work*

In order to prove and move forward this perspective, more theoretical and experimental work should be done. From the latter perspective, experiments should be carried in order to give more quantitative, rather than qualitative, evidence of how ambiguity is related to escalation, proving that escalating behaviors are sustained by the belief that multiple implementation scenarios are possible. Moreover, it would be interesting to test how, given an ambiguous decision context, people that escalate tend to be particularly proactive in manipulating their social and physical environments in order to establish the truth conditions of their beliefs.

In theoretical terms, the enactment perspective offers the possibility to heavily reposition sunk cost research as a protagonist in the field of epistemology by contributing

with a whole set of concepts to the study of how people make sense of situations, negotiate meaning, and construct new realities. From this perspective, sunk cost affected behaviors can be more widely studied as the economic foundation of a constructivist approach to interpretative processes. First, they may give an economic account of how people, when facing ambiguity, tend to adopt a *confirmative* (retrospective) rather than *falsificative* (prospective) reasoning attitude (Latour, 1988). Second, escalation can be viewed as the economic “engine” that sustains and enable the creation and stabilization of meaning. That is, through escalation, people intentionally bound themselves to such confirmative reasoning attitude that tends to assume, rather than prove, the truth value of their beliefs. In this sense, escalation could provide an economic account of how people tend to “reify” meanings in the “world” by intentionally “locking-in” themselves and the others in those interpretations that were once cognitively and socially produced.

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### Appendix: The five scenarios

#### *Airplane*

As the president of an airline company, you have invested 10 million dollars of the company's money into a research project. The purpose was to develop a plane that would not be detected by conventional radar, in other words, a radar-blank plane. When the project is 90% completed, another firm begins marketing a plane that cannot be detected by radar. Also, it is apparent that their plane is much faster and far more economical than the plane your company could build.

The question is: should you invest the last 10% of the research funds to finish your radar-blank plane?

#### *Medicine*

As the president of a pharmaceutical company, you have invested 10 million dollars of the company's money into a research project. The purpose was to develop a medicine that would alleviate the symptom of a disease. When the project is 90% completed, another firm begins marketing a vaccine that recovers from the disease. Also, it is apparent that their vaccine is more effective and less expensive than the medicine your company is developing.

The question is: should you invest the last 10% of your research funds to finish your medicine?

#### *Reclamation*

As the president of a land renovation company, you have invested 10 million dollars of the company's money into a construction project. The purpose was to reclaim a land that will be used as a car-park since in its close proximity a trade center will be constructed. When the project is 90% completed, you being acknowledge that the project of the trade center has been abandoned.

The question is: should you invest the last 10% of the reclamation funds to finish your car-par?

*Oil excavation “150”*

As the president of an excavations company, you have invested 10 million dollars of the company's money into an excavation project. The purpose was to find oil in the Sahara Desert. The point in which to excavate was found using a sophisticated satellite-network based system. When the project is 90% completed, a famous geologist published some data stating that your method to find the point is subject to a calculation error. This error gives an excavation point that is 150 kilometer far from the right place. Also, it is apparent that the data of the geologist are correct and valid and your engineers agree with them.

The question is: should you invest the last 10% of the excavation funds to finish your excavation?

*Oil Excavation “500”*

As the president of an excavations company, you have invested 10 million dollars of the company's money into an excavation project. The purpose was to find oil in the Sahara Desert. The point in which to excavate was found using a sophisticated satellite-network based system. When the project is 90% completed, a famous geologist published some data stating that your method to find the point is subject to a calculation error. This error gives an excavation point that is 500 kilometer far from the right place. Also, it is apparent that the data of the geologist are correct and valid and your engineers agree with them.

The question is: should you invest the last 10% of the excavation funds to finish your excavation?

### Footnotes

<sup>1</sup> “Ambiguity refers to features of decision making in which alternative states are hazily defined or in which they have multiple meanings, simultaneously opposing interpretations. Students of ambiguity argue that information may not resolve misunderstandings of the world; that the “real” world may itself be a product of social construction, thus not so much discovered as invented; that interpretations of experience and desires may be fundamentally ambivalent rather than simply uncertain; and that ambiguity may be used to augment understanding through imagination.” (March, 1994).

<sup>2</sup> As Wenger clearly defines: “We define who we are by where we have been and where we are going. Identity is not some primordial core of personality that already exists. (...) It has coherence through time that connects the past, the present, and the future. (...) As trajectories, our identities incorporate the past and the future in the very process of negotiating the present.” (Wenger, 1998, pp. 149-154).

<sup>3</sup> In the Appendix it is possible to view the five questions.

<sup>4</sup> This scenario is the same used by Arkes and Blumer (1985).

<sup>5</sup> As proposed by Hantula and De Nicolis Bragger this analysis is “predicated on post-hoc analysis that focused on the primacy of hindsight over foresight and can be considered a retrospective fallacy.” (1999, p. 426).

Figures and Tables Captions

*Table 1. Results obtained in each scenario. Positive responses are split in constructive rational and irrational explanations.*

*Figure 1. Sunk cost effect and irrational escalation.*

*Figure 2. The sensemaking process.*

*Figure 3. Commonalities between sunk cost effect and sensemaking.*

*Figure 4. Percentage of the positive responses in the five scenarios.*

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*Figure 6. Within positive responses, percentage of constructive rational and irrational responses.*

*Figure 7. Results of the five scenarios with indication of constructive rational and irrational explanations.*

Table 1: Results obtained in each scenario. Positive responses are split in constructive rational and irrational explanations

	RECLAMATION	AIRPLANE	MEDICINE	OIL EX. 150	OIL EX. 500
	94%	86%	60,8%	37,8%	29,4%
<b>YES</b>	(79)	(49)	(59)	(17)	(20)
<b>CONSTRUCTIVE</b>					
<b>RATIONAL (CR)</b>	86,9%	75,4%	52,6%	26,7%	19,1%
<b>IRRATIONAL</b>					
<b>(IRR)</b>	7,1%	10,5%	8,2%	11,1%	10,3%
	6%	14%	39,2%	62,2%	70,6%
<b>NO</b>	(5)	(8)	(38)	(28)	(48)

$$\chi^2 (1, N=351) = 93,80; p < .001$$

Figure 1: Sunk cost effect and irrational escalation

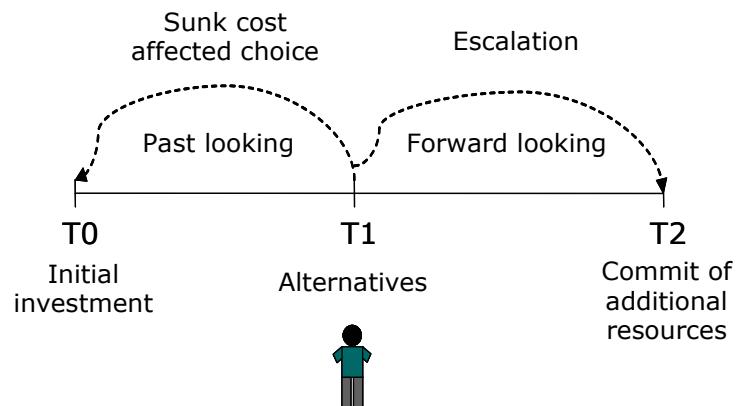
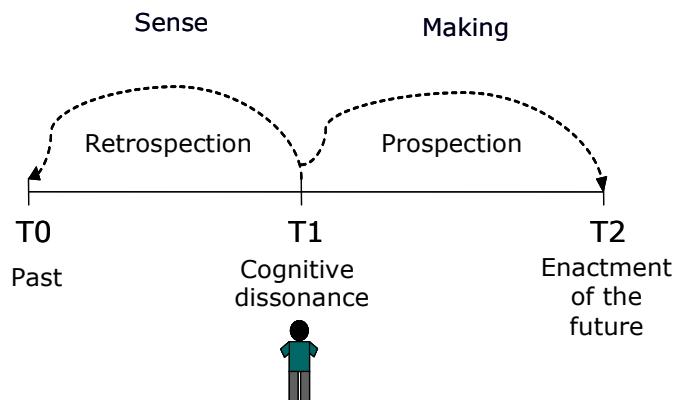


Figure 2: The sensemaking process



**Figure 3: Commonalities between sunk cost effect and sensemaking**

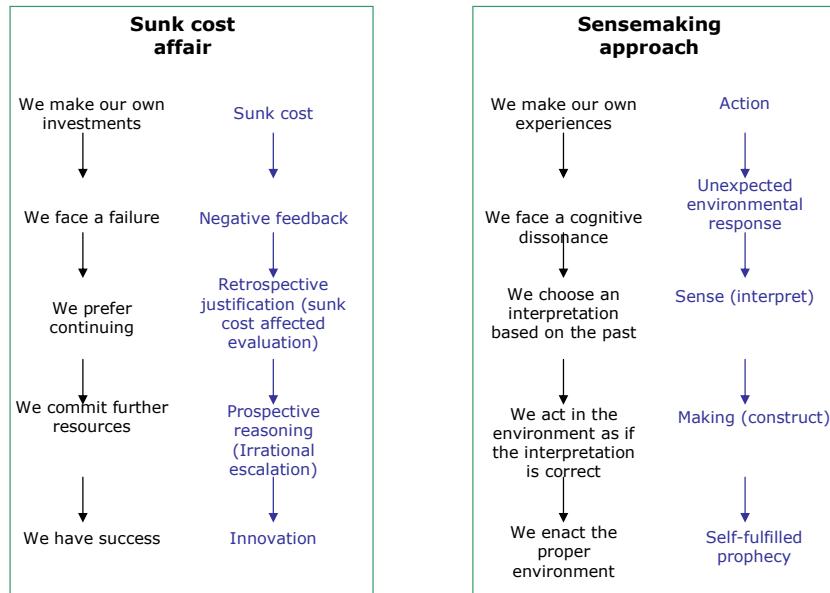


Figure 4: Percentage of the positive responses in the five scenarios

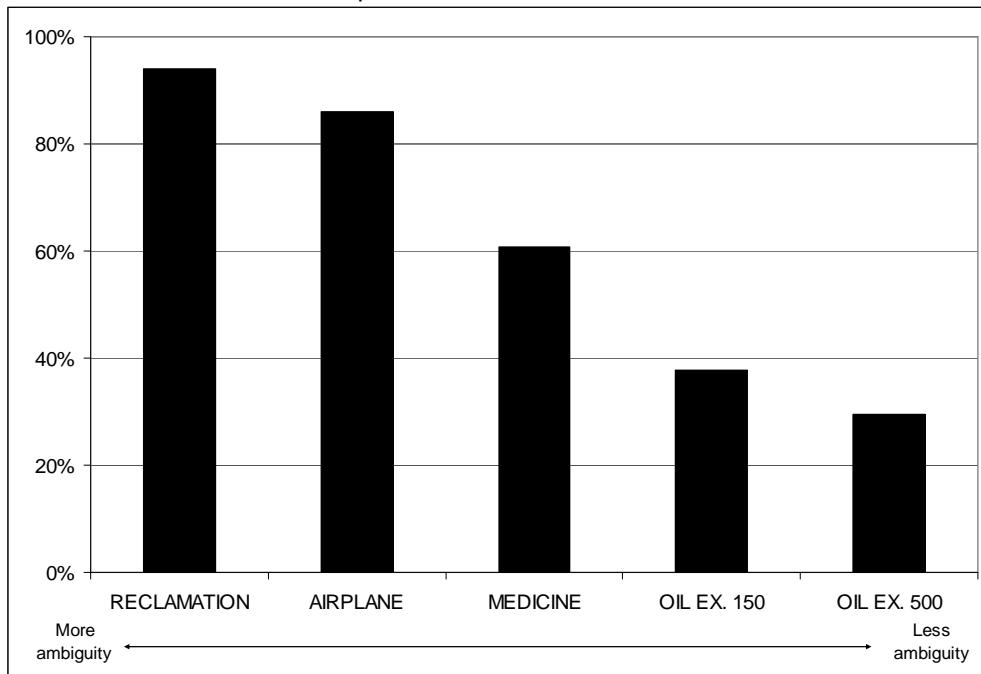


Figure 5: Results of the five scenarios with indication of constructive rational and irrational explanations

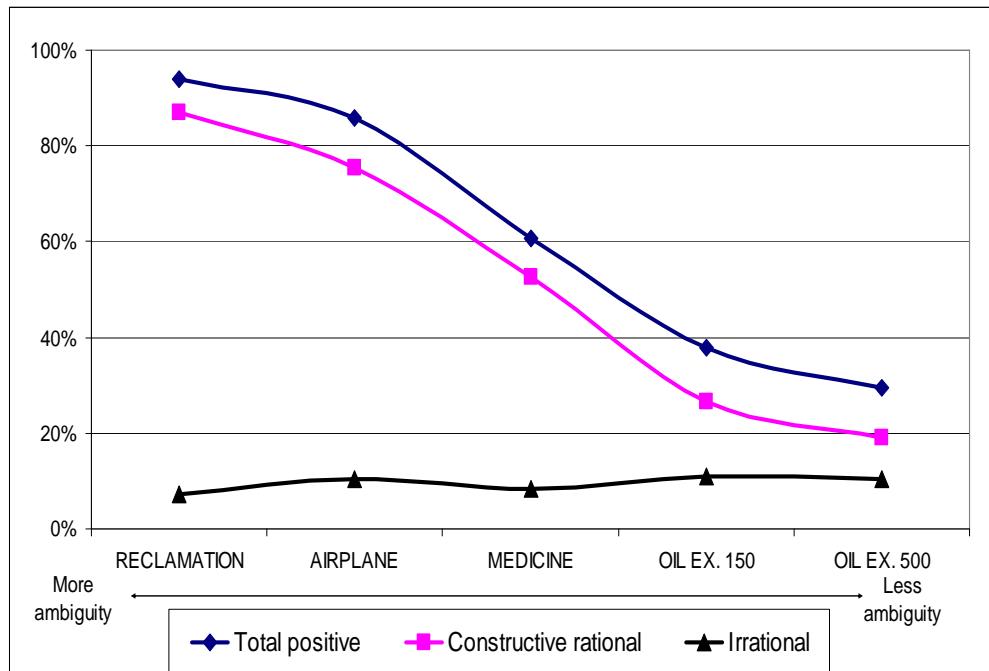


Figure 6: Within positive responses, percentage of constructive rational and irrational responses

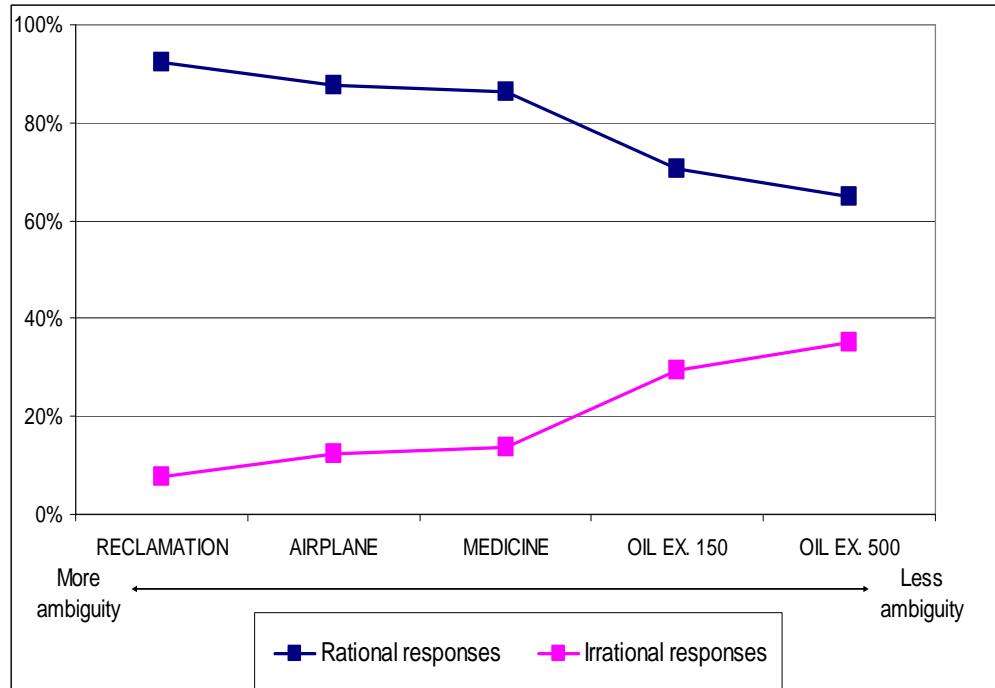


Figure 7: Results of the five scenarios with indication of  
constructive rational and irrational explanations

