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AN INTEGRATIVE PROCESS APPROACH ON JUDGMENT AND DECISION MAKING: THE IMPACT OF AROUSAL, AFFECT, MOTIVATION, AND COGNITIVE ABILITY

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This article aims to integrate the findings from various research traditions on human judgment and decision making, focusing on four process variables: arousal, affect, motivation, and cognitive capacity/ability. We advocate a broad perspective referred to as the integrative process approach (IPA) of decision making, in which these process variables explain the effects of dispositional and situational input variables on information processing and decision making. From this integration, underinvestigated issues that represent promising avenues for future research are delineated, and the merits of the present approach for a more refined interpretation of previous research on judgment and decision making are discussed. We argue that the simultaneous consideration of the various process variables is crucial to advance our insight in this important domain of inquiry.

Key words: motivation, arousal, emotion, cognition, judgment, model

Human judgment and decision making has attracted considerable research attention in various disciplines within psychology. The term *decision making* generates over 25,000 hits in the Social Sciences Citation Index for the last 30 years in the psychological research domain, with an exponential increase in publications during the last decade. Numerous models and theories have been formulated in this broad domain, and recently, the need to integrate this flood of different perspectives has become a very prominent issue in the literature. In the past few years, various authors have made valuable contributions to construct broad models of judgment and decision making that integrate a number of research lines without claiming to be all-inclusive (e.g., Deutsch & Strack, 2006; Forgas, 1995; Kruglanski, Erb, Pierro, Mannetti, & Chun, 2006; Kruglanski, Pierro, Mannetti, Erb, & Chun, 2007; Sherman, 2006). The present article aims to contribute to this quest for integration by developing an overview perspective that incorporates several broad but complementary research traditions that have focused on "within-individual" influences on decision making and judgment.

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Within the vast literature on human decision making and judgment, different research traditions have addressed the influence of arousal, cognitive ability, motivation, and affect. Early theorizing and research (e.g., Yerkes & Dodson, 1908; Easterbrook, 1959) demonstrated the impact of *arousal* but also paved the way for more recent perspectives on decision making that emphasize *cognitive capacity/ability* (for an overview, see Staal, 2004), *motivation* (e.g., Kruglanski & Webster, 1996), and *affect* (e.g., Bodenhausen, Kramer, & Süsser, 1994; Forgas, 1995). However, the absence of a general, conceptual synthesis of the well-established impact of these four key variables is remarkable. Thus, we explicitly aimed to provide a broad perspective that incorporates the four different process variables in decision making, with a strong focus on the relationships and the interplay among these processes. Our goal was to provide a general framework that integrates and extends existing ideas on decision making, yielding a more global understanding of its complex, underlying mechanisms.

We first briefly review the four research traditions, each stressing a different, specific process as a key determinant of decision making (i.e., arousal, ability, motivation, and affect). Next, we consider the theoretical commonalities and considerable (although fragmented) empirical evidence of connections between these different process variables in order to reach a single, comprehensive framework. In the discussion of this framework, we stress the importance of an integrative perspective that includes multiple direct and indirect links between the process variables to explain human decision making, and we identify some promising avenues for future research.

Classical Theories on Performance: Focus on Arousal

Throughout decades of psychological research, several prominent scholars (e.g., Broadhurst, 1957; Hull, 1943; Yerkes & Dodson, 1908) have argued that arousal is a key operator in determining performance and information processing. The Yerkes-Dodson law, represented by the famous inverted U graphic, is probably the best known theory on how arousal affects performance. This law states that moderate levels of arousal result in optimal performance, whereas levels that are too low or too high degrade performance. Many authors have further explored the relationship between arousal and performance (e.g., Broadhurst, 1957; Easterbrook, 1959; Duffy, 1957; Hebb, 1955; Selye, 1956), and alternative models have been proposed (e.g., drive theory; Hull, 1943; Spence, 1951).

Several scholars have also addressed the underlying processes that may account for the effect of arousal on decision making. For example, using epinephrine and methamphetamine injections as manipulations of arousal, Callaway (1959) demonstrated the detrimental effect of high arousal on information processing in decision making. In this regard, Broadbent (1971) asserted that high arousal narrows the attentional field, which, in turn, leads to a restriction in the range of stimuli that is processed. In a related vein, Easterbrook (1959) argued that arousal influences cue sampling (attention allocation), reducing information-processing complexity. More recent work by Mano (1994) and Lewinsohn and Mano (1993) showed that arousal reduces both information-processing time and attentional capacity. The evidence for the effects of arousal on decision making is indeed extensive and compelling. The principal remaining issue here is the degree to which arousal

effects are direct or indirect, that is, mediated through variables such as cognitive capacity and motivation (see Broadhurst, 1957; Easterbrook, 1959; Hammond, 2000; McGrath, 1970; Sells, 1970; Staal, 2004).

The "Stressor" Research Tradition on Decision Making: Focus on Cognitive Capacity/Ability

A large number of studies on decision making have advanced the important role of cognitive capacity, which dates back to the work of Miller (1956) and Simon (1957) and the limited resource models of Kahneman (1973) and Norman and Bobrow (1975). In our model we will also use *cognitive ability* as a general term for this process variable. Importantly, this research considered stressors in terms of "burdens" or "loads." As such, this stressor research tradition in decision making acknowledged that arousal may be a basic operator, but reductions in cognitive ability were proposed as the central explanatory element. For example, Eysenck and Calvo (1992) asserted that individuals under stress demonstrate lower cognitive efficiency due to intrusive cognitions competing for the limited pool of cognitive resources. Other studies demonstrated that time pressure (e.g., Ben Zur & Breznitz, 1981; Payne, Bettman, & Luce, 1996), and noise (e.g., Hockey, 1970), as well as naturally occurring life-event stressors (e.g., Baradell & Klein, 1993), pose a burden on cognitive capacity, increasing errors made on cognitive tasks (see also Leon & Revelle, 1985) and altering the way information is processed, demonstrated by the use of simple decision strategies and the failure to sample complex hypotheses and solutions (e.g., Hockey, 1979; Mandler, 1979). Several authors (e.g., Baradell & Klein, 1993; see also Staal, 2004) have also argued that lowered cognitive ability is associated with hypervigilant decision making, referring to a state of disorganized and haphazard processing associated with frantic search, rapid attention shifting, and a reduction in the number of alternatives that are considered (see Janis & Mann, 1977). In his review of the literature, Staal (2004) concluded that stressors lead to two specific changes in decision making: causing information processing to "become more rigid with fewer alternatives scanned" and inducing the tendency to "persist with a method or problem-solving strategy even after it has ceased to be helpful" (p. 68).

Research on Needs in Decision Making: Focus on Motivation

During the last two decades, numerous studies have shown that motivation is an important determinant of decision making. Motivational constructs such as need for closure (Kruglanski, 1990; Kruglanski & Webster, 1996), need for cognition (Cacioppo & Petty, 1982), and personal need for structure (Neuberg & Newsom, 1993) have recently received much research attention. We elaborate on need for closure as a typical example of a motivational process in decision making because of its strong theoretical base and impressive empirical support, as well as its wide applicability in various areas of social psychology research.

Need for closure (NFC) is defined as the desire or motivation to reach "*an* answer on a given topic, *any* answer . . . compared to confusion and ambiguity" (Kruglanski, 1990, p. 337). Two tendencies that bear remarkable resemblance with those identified in the stressor literature (see Staal, 2004)

are assumed to result from this need. The first tendency refers to the inclination to quickly seize on closure, causing people to leap to judgment based on limited information because "any further postponement of closure is experienced as bothersome" (Kruglanski & Webster, 1996, p. 265). The second tendency refers to protecting or "freezing" on previous decisions to consolidate acquired knowledge and to safeguard this knowledge against new and contradictory information.

NFC effects on decision making have been illustrated by a lowered sensitivity to alternative hypotheses (Kruglanski & Mayseless, 1988), a preference for simplified judgment (Webster & Kruglanski, 1994; Van Hiel & Mervielde, 2003), a higher resistance to persuasion (Kruglanski, Webster, & Klem, 1993), and a less extensive search for information (Klein & Webster, 2000; Van Hiel & Mervielde, 2002). As such, NFC is a typical example of a motivational mechanism determining the extent of predecisional information processing, as well as the degree to which information is used to reach a decision.

Mood Induction Research: Focus on Affect

A growing number of studies (e.g., Bodenhausen et al., 1994; Lerner & Tiedens, 2006; Wegener, Petty, & Smith, 1995) have also demonstrated important effects of affect, mood, and emotions on decision making. Although the aforementioned theories focusing on arousal, ability, and motivation implicitly recognize that affect may influence decision making, these theories only consider affect as a by-product, paying less attention to the exact nature of its influence. For example, NFC theory states that postponement of a decision is experienced as "aversive," but the exact nature of this presumed, negative affect is not expounded at greater length. Also, in the early arousal theories and the stressor literature, negative affect is highly entwined with arousal or stress, and manipulations used in this research generally involved the induction of negative affect to some degree. However, negative arousing emotions represent only a limited part of the emotion domain (see Russell, 1980, 1983). The effects of positive affect on decision making, however, have been largely neglected in arousal, ability, and motivation literature, whereas in affect research, exactly this type of affect was found to have detrimental effects on information processing and to increase the use of a superficial and cursory style of thinking (e.g., Mackie & Worth, 1989, 1991; Schwarz, Bless, & Bohner, 1991; Worth & Mackie, 1987). Several studies have demonstrated that feelings of happiness decrease message scrutiny and increase the use of heuristics as a basis for judgment when compared to neutral or sad moods (e.g., Bodenhausen et al., 1994; Wegener et al., 1995). Additionally, happy moods decrease attention to argument strength in persuasion tasks (e.g., Schwarz et al., 1991), whereas such effects were not found with sad or neutral moods. These findings led researchers to conclude that "happy moods are associated with a heuristic processing style in which attitudes and judgments are based on peripheral cues rather than a thoughtful consideration of the information, whereas sad moods are associated with a systematic processing style in which attitudes and judgments are based on a careful scrutiny and elaboration of information" (Isbell, 2004, p. 341). It should be noted, however, that this connection is not absolute (see, e.g., Aspinwall, 1998).

Importantly, affect research has also gradually moved beyond simply examining the impact of positive versus negative affective states or moods. Recent studies have revealed the importance of specific emotions in decision making, showing that information processing can differ substantially between emotions that share negative valence like sadness and anger (see Bodenhausen, Sheppard, & Kramer, 1994; Lerner & Tiedens, 2006).

In the remainder of this article we use the term *affect*—in line with Forgas (1995)—as a generic term to refer to mood states as well as specific emotions. Although the influence of moods and specific emotions may in some cases be somewhat different, for the present purposes we do not explicitly differentiate between them, as the general principles presented later should apply to all kinds of valenced affective states.

The Present Integrative Process Approach (IPA)

Considering the vast amount of research on the various aspects that underlie human decision making, a broad theoretical perspective incorporating the ideas from the aforementioned research traditions is necessary for seeing the wood for the trees. Moreover, a comprehensive perspective could help us to develop new, interesting research lines, and it should advance our understanding of the multiple relationships among the process variables.

The preliminary model depicted in Figure 1 is referred to as a saturated model because it contains all possible relationships between the four process variables of arousal, cognitive ability, motivation, and affect. In the remainder of this article we demonstrate that various relationships have been firmly established by empirical studies, whereas other paths of great theoretical relevance have received only scant research attention and constitute promising avenues for future research. Our goal was to arrive at a parsimonious model that accommodates for the most important relationships between the process variables, information processing, and decision making.

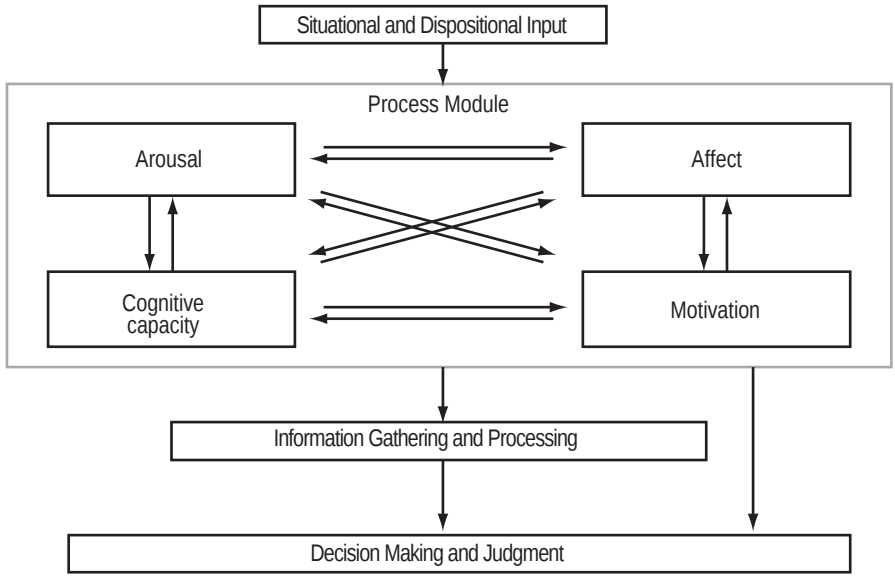

Figure 1. Preliminary integrative process approach of decision making (saturated model).

The present IPA assumes that situational and dispositional variables (input) can direct the four main process variables in decision making: arousal, cognitive capacity, motivation, and affect. These key variables, constituting the "process module," are partially interdependent, and their effects on information processing act through mediation and in interaction with each other. Empirical evidence for the relations among these process variables is reviewed and elaborated upon later. Because of the broadness of the domain under investigation, this review does not aim to be exhaustive. Instead, we present a variety of exemplary studies that illustrate the relationships between the various process variables. Finally, we argue that the extent and style of information processing generally determine decision making and judgment. However, in line with the affect infusion model (Forgas, 1995), the IPA also acknowledges the direct impact of some process variables on decision making that bypass the information-processing route.

Input: Situational and Dispositional Variables (Path A)

First, we address how situational variables as well as individual traits affect the different process variables underlying decision making. The importance of both types of input factors has been acknowledged in NFC theory (Kruglanski & Webster, 1996) and the affect infusion model (Forgas, 1995), but most research on the effects of arousal, cognitive capacity, and affect has primarily focused on situational manipulations, largely neglecting the role of individual traits. However, it is our firm belief that both dispositional and situational variables should be considered as important input factors in decision-making models.

Various dispositional input variables have been proposed in the literature. Dispositional NFC has already been mentioned as an example, and ample studies (e.g., Kruglanski et al., 1993; Roets & Van Hiel, 2007; Roets, Van Hiel, & Cornelis, 2006) have demonstrated the powerful effects of this trait variable on decision making. Other studies have also reported on the influence of intelligence on decision making (e.g., Bröder, 2003), demonstrating that especially fluid intelligence affects performance on dynamic decision-making tasks (Gonzalez, Thomas, & Vanyukov, 2005).

Situational input variables, on the other hand, refer to the context in which decisions are made. The presence of time pressure, noise, fatigue, and evaluation apprehension, but also circumstances that induce a positive or negative mood, are examples of such specific situational characteristics that can affect decision making. The impact of these situational influences has been investigated in numerous studies within different research traditions, establishing their indisputable effects on decision making in laboratory and real-life situations (for an overview, see, e.g., Kruglanski, 2004; Staal, 2004).

Most important, however, in addition to the simple effects of situational and dispositional input factors, the interaction effect between these variables should also be taken into account. Although research tackling the interplay between disposition and situational variables on decision making is rather scarce, a number of studies that addressed this interaction demonstrated the importance of such effects. Wofford, Goodwin, and Daly (1999), for example, found that low trait-anxious individuals are less prone to the negative effects of temporary stressors on cognitive performance

than high trait-anxious individuals. Additionally, Dechesne, Janssen, and van Knippenberg (2000) reported an interaction between situationally induced mortality salience and dispositional need for closure, affecting social judgments. Bröder (2003) demonstrated that the decision strategy chosen in a simulated stock market paradigm was determined by the interaction between situation and intelligence. This type of interaction study, however, remains scarce, and we believe that more research is still necessary to further advance our understanding of the psychological dispositions under which situational effects have more versus less impact on decision making.

Relationships Between the Process Variables in Decision Making: Arousal, Affect, Cognitive Ability, and Motivation

In the preceding summary of the different research traditions, the main effects of arousal, cognitive ability, motivation, and affect are described separately, as if they operate in isolation. However, we strongly believe that a perspective focusing only on these isolated effects would be a blatant simplification of reality, and we argue that there are important connections between the process variables. In the following section, we extract the most important connections and describe and visualize them in greater detail (see Figure 2). To keep the balance between parsimony and comprehensiveness, some less prominent or unsubstantiated paths were omitted from the model.

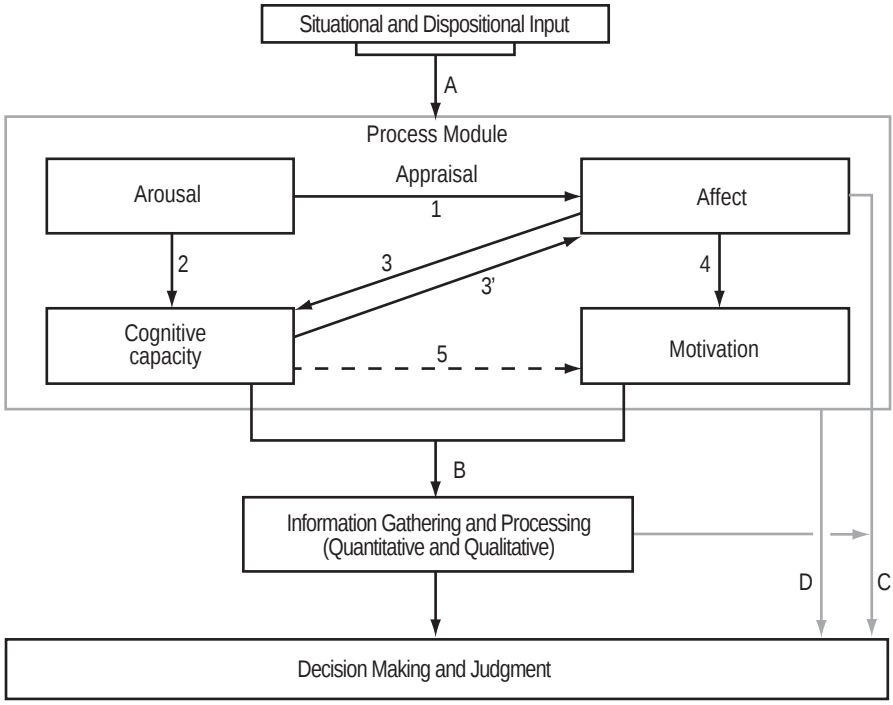

Figure 2. Integrative process approach of decision making (advanced model).

The Relationship Between Arousal and Affect (Path 1)

Although a comprehensive literature review on the relationship between arousal and affect is beyond the scope of the present article, it is important to address a few issues that clarify the nature of their relationship. Arousal has been assumed to be a primary source of emotions in several prominent theories for over a century, reflected in the seminal works of James (1894), Arnold (1960), and Schachter (1964). Later, the appraisal approach of emotion (see, e.g., Scherer, 1988; Smith & Ellsworth, 1985) highlighted the moderating role of cognitive appraisal in the formation of emotions. Depending on the situation and the subsequent appraisal, high arousal may lead to positive as well as negative emotions. Similarly, very low levels of arousal can be appraised as positive (e.g., contentment) as well as negative (e.g., boredom), as has been argued by, for example, Reeve (1992). Nevertheless, several studies have demonstrated that arousal can also influence affect without identifiable appraisal (e.g., Maslach, 1979; Zimbardo, LaBerge, & Butler, 1993); when people do not have an explanation for their elevated arousal, negative affect is generally inflicted and arousal is interpreted as aversive by default. Arousal in itself can thus be the source of specific emotional states, which in turn may account for the effects of arousal on decision making. Evidently, the fact that high arousal can induce emotions does not imply that emotions only stem from appraisal of high arousal. Feelings of contentment or depression, for example, occur with low levels of arousal, and emotions differ not only in arousal level but also in affect valence (see Russell, 1980). Additionally, Sinclair and Mark (1995) demonstrated that the effects of mood states on decision making may also occur regardless of arousal level (see also Bodenhausen, Kramer, et al., 1994).

To conclude, although affect is not determined by arousal alone, arousal is without doubt an important source or precursor of affect. Path 1 therefore depicts the direct effect of arousal on affect.

The Relationship Between Arousal and Cognitive Ability (Path 2)

Classic research has revealed that arousal reduces cognitive abilities (e.g., Broadbent, 1971; Callaway, 1959; Easterbrook, 1959; Eysenck, 1977), a finding that has been corroborated by recent studies. Baron (2000), for example, reported that arousal compromises attentional capacity, reducing the ability to carefully evaluate the available information (see also Lewinsohn & Mano, 1993). Along similar lines, Reich and Zautra (2002) concluded that high stress reduces a person's ability to process information. Based on the empirical evidence supporting the assumption that high arousal can reduce cognitive abilities, Path 2 has been incorporated in the process module of the IPA. However, we want to note that the path between arousal and affect that we described earlier, in combination with the path between affect and ability that we describe next, also allows the IPA to accommodate for (partial) mediation of the effect of arousal on cognitive capacity through affect.

The Relationship Between Affect and Cognitive Ability (Path 3 and Inverse Path 3')

Research on the role of affect in information processing and decision making has demonstrated that affect may reduce cognitive ability (e.g.,

Isen, Means, Patrick, & Nowicki, 1982; Shiffrin & Schneider, 1977, for positive moods; Ellis & Ashbrook, 1988, for negative moods). Several explanations for the effect of mood on cognitive capacity have been put forward by Mackie and Worth (1989). Moods may activate mood-congruent materials stored in memory, which, in turn, reduce the working space of the limited cognitive system (see also Isen & Schalker, 1982; Shiffrin & Schneider, 1977). Moreover, the easy accessibility of these materials may defocus attention (Isen, Daubman, & Nowicki, 1987). Along similar lines, it has been proposed that positive as well as negative emotional material draws attention to itself and acts as a distracter, interfering with the ability to engage in elaborative processing (e.g., Petty & Brock, 1981; see also Ashcraft, 2002; Ashcraft & Kirk, 2001; Eysenck & Calvo, 1992). Overall, it is suggested that affect itself triggers specific affect-related cognitions that interrupt ongoing cognitive processes, directing attention, memory, and judgment to address the affect-eliciting event itself (Johnson-Laird & Oatley, 1992; Lazarus, 1991; Lerner & Tiedens, 2006; Schwarz, 1990; Simon, 1967; Tooby & Cosmides, 1990).

However, it is also important to note that numerous studies have used the experience of failure on cognitive tasks as a manipulation to induce negative affect (for a meta-analysis, see Nummenmaa & Niemi, 2004). These studies have shown that the sheer experience (or even expectation) of insufficiency of cognitive ability may also activate or increase negative feelings. Therefore, we included the path from cognitive ability to affect in the model (Path 3' in Figure 2).

The Relationship Between Affect and Motivation (Path 4)

A dominant model in emotion literature—the affect-as-information model (AAI; Schwarz, 1990)—postulates that affect provides individuals with information about the benign or problematic nature of a psychological situation. Positive affect signals that the environment is safe, thereby also indicating that careful and detailed processing is unnecessary, which in turn decreases the motivation to process information. Conversely, because negative affect signals the presence of a problem, people are motivated to scrutinize the situation carefully, leading them to engage in more elaborate information processing. Hence, the AAI model generally explains the effects of affect on information processing as being at least partially mediated through motivation (see also Wegener et al., 1995).

Other explanations of the influence of affect on information processing acknowledge the role of motivation as well. Mackie and Worth (1989) suggested that a positive mood motivates people to avoid elaborate reflection because this is experienced as difficult and potentially threatening to the maintenance of the positive mood. No reduction of information processing is expected when such mood threats are absent or when processing supports a positive mood. Indeed, Wegener et al. (1995) demonstrated that the effect of positive mood on information processing depends on the "hedonic" properties of the information processing. Also, when task engagement contributes to a negative mood, people may be motivated to reach decisions prematurely, since this is the most straightforward action to end this bothersome situation (see Wegener & Petty, 1994). Similarly, NFC theory states that when information processing is perceived as aversive or frustrating, people are highly motivated to reach closure quickly (see Roets & Van Hiel, 2008). Hence, in

line with Lerner and Tiedens (2006), we conclude that moods "activate a meta-level motivation that influences judgment outcomes and processing" (p. 128). In particular, negative moods are generally associated with a "mood repair" motive, whereas positive moods are associated with a "mood maintenance" motive.

Happy moods also increase confidence in the validity of abstract information (see Bless, 2001; Wyer, Clore, & Isbell, 1999), and some researchers (e.g., Isbell, 2004) have suggested that this confidence accounts for the effects on decision making. However, we believe that this explanation does not eliminate the role of motivation. Indeed, Lerner and Tiedens (2006) specifically argued that "uncertainty reduction has been a widely recognized human motivation" (p. 128) and that "the certainty dimension is more important than the valence dimension in determining whether an emotion results in heuristic or systematic processing." (p. 126). It is thus argued that the uncertainty appraisal dimension of affect invokes specific motivations related to uncertainty reduction.

In conclusion, affect is believed to influence information processing through motivation, which can be explained in terms of affect as information, the hedonistic principle, and uncertainty reduction.

The Relationship Between Cognitive Ability and Motivation (Path 5)

Some scholars have suggested that cognitive ability and motivation may have a causal relationship (e.g., Hess, 2001; Kruglanski & Webster, 1996). This hypothesis reflects the idea that lacking the necessary proficiency to perform well has a detrimental impact on motivation. Kruglanski and Webster's (1996) findings with respect to resistance to persuasion, derogation of opinion deviates, and judgmental confidence have provided some indirect evidence for this idea. Recently, Roets and Van Hiel (in press) demonstrated that the reduction of cognitive capacity in the initial phase of a decision task led to a substantial decrease in information-processing motivation in a later phase of the task. Although the impact of cognitive ability on motivation still needs further empirical support, this causal link may have important implications for information processing in decision making (see Roets & Van Hiel, in press) and was therefore included. Nevertheless, the IPA also allows for the effect of cognitive ability on motivation to be indirect (through Paths 3' and 4 described previously), and future research will have to determine to what degree the effect of ability on motivation is direct or mediated through affect. The direct path from cognitive capacity to motivation in our model (Path 5) should therefore be considered conditional and will be discussed later.

Other Connections Between the Process Variables

In the previous sections we provided empirical evidence for several prominent connections between the process variables, resulting in a parsimonious model for the IPA (see Figure 2). Paths for which empirical evidence and theoretical rationale are currently lacking were omitted in the parsimonious model. We acknowledge that these omissions may be debatable and should not necessarily be considered final (see the General Discussion section). Nevertheless, we believe that our parsimony approach is defendable because of the present lack of theoretical and empirical basis for the *direct*

and causal nature of the omitted paths. For example, a direct, causal path from arousal to motivation was omitted because accounts on the motivational consequences of arousal typically include some degree of appraisal in terms of affect. For example, Welford (1973) asserted that high levels of arousal (stress) can be viewed as an aversive state of being removed from an optimal condition, suggesting that motivation plays a role in spurring action against this departure from the optimal state because of its unpleasant nature. Therefore, our model favors an indirect path between arousal and motivation through affect (Paths 1 and 4) over a direct connection.

Effects of the Process Variables on Decision Making

Effects on Decision Making Through Information Processing: Impact of Motivation and Cognitive Capacity (Path B)

In the present IPA, all four process variables play a role in information processing before a decision is made. However, it is argued that cognitive ability and motivation directly affect information sampling and processing, whereas the impact of arousal and affect generally occurs indirectly through the two former process variables. The assumption that ability and motivation are the two process variables that directly affect information processing is in line with classic dual-mode models (e.g., Chaiken, Liberman, & Eagly, 1989; Petty & Cacioppo, 1986) as well as recent unimodels (e.g., Kruglanski et al., 2007) on information processing in decision making and judgment. Although the debate continues about whether or not qualitatively different processing modes should be distinguished (see, e.g., *Psychological Inquiry*, 2006, *17*[3]), there is an overall consensus that motivation and ability represent the central "decision-maker" process variables determining information processing.

However, empirical research investigating the effects of motivation and ability on information processing has often focused on their main effects, and to date relatively few scholars have explicitly tested how the effects of these two variables in decision making may be interdependent. Remarkably, different patterns have been proposed on the nature of this interaction. On the one hand, it has been advanced that high motivation may compensate for low ability (see, e.g., Kruglanski et al., 2007; Roets, Van Hiel, Cornelis, & Soetens, 2008), which is grounded in general models on effort investment (e.g., Brehm & Self, 1989; Hockey, 1997; Wright & Kirby, 2001). Applying this compensation perspective on information sampling investment in judgment tasks, Roets et al. (2008) indeed showed that low levels of ability resulted in an increase in information sampling when motivation was high, but not when motivation was low. On the other hand, Pelham and Neter (1995), as well as Roets, Van Hiel and Kruglanski (2010), demonstrated that high motivation often hampers decision making when cognitive ability is insufficient (see also Bar-Tal, Kishon-Rabin, & Tabak, 1997). These findings led to the conclusion that motivation may not compensate for low cognitive ability but instead may amplify the debilitating effects of low ability on decision making.

To understand these divergent findings, we refer to Roets et al. (2010), who argued that it is crucial to differentiate between two orthogonal aspects of information processing in decision making: the amount of predecisional information sampled (cf. "quantity") on the one hand and the subjective

perception of its usefulness (cf. "quality") on the other hand. In particular, high motivation may compensate for low ability by increasing the amount of information that is consulted, but it is detrimental, rather than helpful, for the individual's appreciation of information's potential relevance. Importantly, various studies that focused on the effects of motivation and ability on actual decision outcomes revealed debilitating rather than compensating effects of high motivation under low ability (see, e.g., Bar-Tal et al., 1997; Pelham & Neter, 1995). It is therefore suggested that the interaction effect between motivation and cognitive capacity on the actual decision outcome is primarily determined by the quality aspect, rather than by the quantity aspect. Roets et al. (2010) explicitly tested this hypothesis and found that the motivation × ability effect on decision outcome was fully mediated by perceived information relevance, whereas information quantity played no substantial role. In the General Discussion section, we will further elaborate on the value of distinguishing between the quantitative and qualitative aspect of information processing to get a better insight into the interaction effects of motivation and ability and the impact on decision outcomes.

Comprising the individual effects of motivation and cognitive ability, as well as their interaction effects on information processing, Path B is included in Figure 2 as a prominent path in the IPA.

Non-Information-Based Effects on Decision Making: Affect and Motivation Infusion

The present perspective on motivation and ability as the most proximal process determinants of information processing does not mean that the other process variables are of secondary importance in decision making, in particular when it comes to affect. Indeed, although the impact of affect on information processing is generally indirect, we argue—based on the work by Forgas (1995) described below—that affect may also have direct effects on the final decision itself (rather than on the preceding information-processing stage). The IPA therefore also accommodates a path allowing affect (and particular motivation types) to influence or "infuse" decisions directly, bypassing the information-based decision process under specific conditions.

Affect infusion. Forgas (1995) proposed the affect infusion model (AIM), which, analogous to the present model, hypothesizes that affect has an impact on both cognitive capacity and motivation, which in turn determine the information-processing extent and strategy. However, Forgas argued that in some specific information-processing strategies, affective states may also influence decision making directly, labeled *affect infusion* (e.g., resulting in mood-congruent decisions). The first of these strategies is the heuristic processing strategy, which uses shortcuts like the affect-as-information mechanism to reach decisions and typically occurs when general (accuracy) motivation or cognitive capacity is low. The second strategy allowing for high affect infusion is the substantive processing strategy, which involves a profound information search with constructive processing to frame the novel information in existing knowledge. This strategy typically occurs when both general motivation and cognitive capacity are high and is prone to affect infusion because affect-priming mechanisms influencing the decision receive a larger window of opportunity due to the elaborative nature and duration of the information processing (Forgas, 1995).

Low affect infusion, on the other hand, is expected in a direct-access strategy, which is based on retrieval of an existing crystallized judgment. Such strategy is used when a prior judgment can serve as example and personal relevance of the decision is low, typically leading to low general motivation. The second low-infusion strategy is the motivated processing strategy. Importantly, this strategy does not refer to the presence of high general motivation to make an accurate decision but to specific motivational pressures for a particular decision outcome, regardless of the available information. Forgas (1995) characterized this information-processing strategy as a prejudiced and partial search for information to confirm the validity of that particular answer or decision.

Motivation infusion. Whereas AIM highlighted that judgments may be infused with affect, we argue that infusion is also possible for a specific type of motivation. In particular, both AIM and NFC theory (see Kruglanski & Webster, 1996) have recognized that decision makers may sometimes be motivated to reach a particular decision. In AIM, this has been acknowledged in the motivated processing strategy, whereas NFC theory posits a similar strategy in which high need for *specific* closure is characterized by a biased search for information, in function of the desired answer or decision. Of importance to the present perspective, we propose that besides evoking selective information processing, the motivation to reach a particular decision can also affect the decision outcome directly, attesting to the possibility of specific motivation infusion, similar to the affect infusion described by Forgas (1995). In particular, when the motivation to reach a specific decision is very high, it has the potential to overrule any inclination toward different decision outcomes (see also Brownstein, 2003; Kunda, 1990). Hence, the decision maker is likely to reach this particular, preferred decision even in the absence of confirming evidence or the presence of disconfirming evidence for this decision. However, whereas the presence of affect still allows for all four strategies and the possibility of affect infusion then merely depends on the chosen strategy (see Figure 2, Path C), directional motivation evokes the motivated processing strategy by definition, implying that motivation infusion relies entirely on the use of this strategy (see Figure 2, Path D).

In sum, the IPA incorporates the basic premise of Forgas's (1995) AIM, stating that with some information-processing strategies, affect may impact directly upon the eventual decision and lead to affect-congruent or affect-incongruent decisions, which are not fully determined by the information processing. However, the IPA additionally states that a strong specific motivation to reach a particular decision may also lead to decisions that are not information based. Although such mechanisms that bypass the information-processing component are certainly not relevant in every decision-making process, they can significantly influence the decision outcome and are therefore acknowledged in the final representation of the IPA, indicated by Paths C and D (Figure 2).

General Discussion

The goal of the present article was to promote an integrative perspective on information processing and decision making, based on the findings of four research traditions, each focusing on a specific process variable: arousal, affect, cognitive capacity/ability, and motivation. We assessed the

empirical status of the relations among these variables in the literature and also identified paths that have received little research attention, despite their apparent relevance to the study of decision making.

One of the central aspects of this integrative process approach pertains to cognitive ability and motivation being the most proximal process variables directly affecting information processing. Because of their central role in the present perspective, we believe a closer investigation of the underinvestigated interplay between these process variables is essential and hence constitutes the first focal issue we will discuss. As a second, more general issue, we argue that the considerable evidence for multiple relationships among the process variables (summarized in Figure 2) indicates that the treatment of these variables as if they operate in isolation is too narrow an approach to study human decision making. The IPA proposed here offers a new, more sophisticated way of thinking about decision making, based on the idea that the process variables are related to each other. To illustrate this, we present two cases that show how a single input factor can have multiple direct and indirect effects on various process variables, thereby affecting the entire system. Finally, we discuss how future research may use different research methods to investigate the various claims of the IPA.

Clarifying the Interplay Between Cognitive Ability and Motivation in Decision Making

One of the most remarkable blind spots in the literature on human decision making pertains to the interplay between cognitive ability and motivation. This interplay is without a doubt the most intricate part of the IPA: Not only can ability and motivation be causally related rather than being independent (Path 5), but these variables can also have important but diverse interaction effects (Path B).

The possibility of a causal relationship between cognitive capacity and motivation has already been proposed by Kruglanski and Webster (1996), who explicitly advanced the idea that depletion of cognitive resources may impede motivation. Only recently, this hypothesis was empirically substantiated by Roets and Van Hiel (in press), who pointed to the importance of acknowledging this effect in decision-making research. In this regard, it should be noted that the IPA also indicates that affect may partially mediate the causal relation between cognitive capacity and motivation (i.e., through Paths 3' and 4). In particular, the experience of inadequate cognitive capacity activates aversive feelings, which, in turn, may decrease motivation to invest in elaborate and lengthy predecisional information processing.

The interaction between cognitive ability and motivation is probably even more fundamental to the study of decision making. Indeed, although cognitive ability and motivation are central variables in influential theories on decision making (e.g., Chaiken et al., 1989; Forgas, 1995; Kruglanski et al., 2007; Petty & Cacioppo, 1986), explicit consideration of their interaction has been rather limited. Nevertheless, the occasional empirical studies that have addressed this issue have reported substantial interaction effects. Importantly, as we noted before, the nature of this interaction depends on which aspect of the decision-making process is investigated. In particular, high motivation under low ability might increase the amount of sampled information (see, e.g., Roets et al., 2008), but it hampers the perception of the

potential relevance of this information (see Roets et al., 2010). Notably, various studies revealed debilitating effects of high motivation under low ability on actual decision outcomes (e.g., Bar-Tal et al., 1997; Pelham & Neter, 1995), which suggests that perceived information relevance has a greater impact than information quantity on the decision outcome. This assumption was recently corroborated by Roets et al. (2010), who showed that the interaction effect of motivation and cognitive capacity on a decision outcome was fully mediated by perceived information relevance. However, it may be hypothesized that when information is univocal to a degree that does not allow any differences in relevance appreciation, the compensation effect of high motivation on information-processing quantity might still bolster the accuracy of the decision outcome.

In conclusion, we want to highlight that cognitive ability and motivation can be considered interdependent (i.e., causally related) process variables that affect decision making in interaction with each other by determining both the quantitative and the qualitative aspect of information processing. Despite the theoretical importance and practical relevance of the dynamic interplay between cognitive ability and motivation, empirical studies investigating this crucial matter in its full complexity are lacking. We therefore strongly believe that this type of research should be given absolute priority in order to advance our understanding of the processes underlying human decision making.

The Model in Action: From Input to Decision Making Through Multiple Direct and Indirect Paths

In this section, we show that the IPA provides a more sophisticated perspective on information processing in decision making compared to extant research traditions, thus generating interesting research questions that may guide future studies. In particular, we address the multifaceted way in which a single dispositional or situational input variable may impact upon multiple processes, causing differential effects on information processing and decision making. Previous research generally focused on the effect of a single input factor on a single process variable. However, in addition to its obvious direct effect on a particular process variable, a single input factor can have (a) considerable *indirect* effects on several other process variables and (b) *direct* effects on more than one process variable. In the following, we demonstrate how the effects of a single input variable may operate through various indirect paths and/or multiple direct paths, presenting dispositional NFC and noise manipulations as two noteworthy illustrations.

Indirect effects of input variables on process variables. Individual differences in NFC (Webster & Kruglanski, 1994) have generally been assumed to relate straightforwardly to individual differences in motivation to process information. However, closer investigation of the possible pathways through which dispositional NFC affects motivation in terms of the present model reveals an interesting alternative account for this direct relationship. In particular, the IPA suggests that the NFC effect on motivation may also result from changes in arousal and affect. Empirical evidence for the role of arousal and affect in dispositional NFC was provided in a recent study by Roets and Van Hiel (2008), who demonstrated that during decision making, people high in dispositional NFC experience higher levels of arousal (assessed by galvanic

skin response and cardiovascular measures) and report more emotions of distress (negative valence and high activation). According to the IPA, these elevated levels of arousal and negative emotions may then be the source (through Paths 1 and 4) of the motivation to reach closure, that is, the desire to end the burdensome and aversive decision-making process by reducing the extent of information processing and reaching a decision as soon as possible. Hence, the motivational nature of dispositional NFC may partially have its underpinnings in arousal and affect and seems more sophisticated than a narrow approach on NFC solely in terms of motivation. This also implies that the effect of NFC on motivation can be weakened by interventions on these mediating process variables, for example, if (a) arousal increments during the process are prevented (e.g., by active or substance-induced relaxation) or (b) negative affect is prevented (e.g., by making the decision task inherently pleasant, countering the aversive nature of lacking closure).

Multiple direct effects on process variables. Some input factors may also *directly* affect multiple process variables (with indirect effects branching out from these variables). For example, noise has been shown to provoke increased arousal (e.g., Broadbent, 1971; Paulhus & Lim, 1994) as well as lowered cognitive capacity (e.g., Hockey, 1970). Reduced cognitive capacity under noise could then be explained by an indirect effect through arousal (Path 2), similar to the indirect effects of dispositional NFC on motivation described previously. However, it is also likely that noise directly affects cognitive abilities. In the latter case, the noise itself acts as a distracter, taxing the limited cognitive resources. Arousal and distraction theories have both been regarded as valuable explanations for the effect of noise in decision making (see Hockey, 1979, 1983; Staal, 2004). The IPA explicitly incorporates both explanations, advancing that they should not be considered as competing hypotheses, the first hypothesis being that reduced cognitive capacity under noise occurs independently from arousal and the second being that the effects of noise on cognitive capacity are fully mediated through increased arousal. Instead, we advance that both perspectives are compatible, and we hypothesize partial mediation of the impact of noise on cognitive capacity through arousal.

Importantly, multiple direct effects do not exclude additional indirect effects. In particular, an interesting indirect path through which noise may affect information processing pertains to noise indirectly affecting motivation. The impact of noise on motivation has been abundantly demonstrated in NFC research, which often used noise manipulations to alter information-processing motivation. Future research, therefore, may also elaborate on the hypothesis that noise effects on motivation occur indirectly, partially mediated through other process variables. In this regard, Roets and Van Hiel (in press) have already indicated that cognitive capacity is indeed a partial mediator in this effect.

These two examples illustrate the interplay between the various process variables, much neglected in previous research but explicitly accommodated for by the IPA. To conclude, input variables influence one or more processes directly, which in turn may have an impact on other processes through indirect and spill-over effects. Importantly, because of the explicit presence of various direct and indirect effects, the IPA may provide a more refined interpretation of the empirical findings from previous studies, beyond the limited scope of their respective research traditions.

Future Directions

In summary, the integrative process approach is a generative perspective that not only encourages a more sophisticated view on the relevant processes underlying the effects obtained in previous research but also enables researchers to formulate various interesting hypotheses for future empirical studies, as illustrated by (but not limited to) the cases we presented previously. Table 1 summarizes some of these avenues for future research that can be derived from the IPA. The appeal of the individual hypotheses and their innovative nature may depend somewhat on the specific research background of the investigator, but they all refer to a general, promising approach that simultaneously considers multiple direct and indirect effects of arousal, affect, cognitive ability, and motivation on information processing. We strongly believe this approach is necessary to advance our insight into the complex processes underlying human information processing and decision making.

Table 1
A Sample of General and Specific Issues for Future Research Highlighted by the Integrative Process Approach (IPA)

Interaction effects	
Disposition × situation interaction effects on arousal, affect, cognitive capacity, and motivation	Path A
Situational influences on process variables depend on individual susceptibility.	
Dispositional influences on process variables depend on the situation.	
Cognitive capacity × motivation interaction effects on information processing	Path B
Under low cognitive capacity, high motivation increases information sampling (quantity).	
Under low cognitive capacity, high motivation hampers relevance perception of sampled information (quality).	
Mediated effects between process variables	
Effects of arousal on cognitive capacity are (partially) mediated through affect.	Paths 1 + 3
Effects of cognitive capacity on motivation are (partially) mediated through affect.	Paths 3' + 4
Mediated effects on information processing	
Effects of arousal on information processing are mediated through cognitive capacity and motivation.	Path 2 & Paths 1 + 4
Effects of affect on information processing are mediated through cognitive capacity and motivation.	Path 3 & Path 4
Direct effects on decision outcome	
If directional motivation is present, decision outcome is directly affected (i.e., motivation infusion), in addition to effects through the information-processing route.	Path D
Multifaceted effects	
Cognitive capacity influences motivation and their combined and interaction effects determine information processing.	Paths B & 5 and/or 3' + 4
Multiple direct and indirect effects of input variables on process variables.	Multiple paths A + Paths 1 to 5

To cope with the challenges posed by the IPA, future research should use a combination of various research methods. Experimental studies are indispensable to test some of the hypothesized effects, such as the specific mediation effects represented by the indirect paths in the model. These experimental studies represent a first step in expanding the "focal approach" that is characteristic of the discrete research traditions to a more global perspective on the underlying processes of information processing in decision making. However, we should acknowledge that the experimental methodology is limited, as it only allows the simultaneous investigation of selected parts of the IPA. Hence, a second step, aligning well with the present perspective and representing a more dramatic focal-to-global paradigm shift in the study of decision making, constitutes a "structural-connectionist" approach, examining the simultaneous operation of all process variables affecting information processing. This step is certainly the most intricate one, as it requires adequate measurement of all individual process variables to identify not only the impact of specific input variables on different process variables in the IPA, but also the magnitude and nature of their connections. The major challenge here is the identification of appropriate, straightforward measures of the four distinct process variables. Interestingly, new developments in the domain of connectionist modeling and computer simulation studies may also provide useful tools to examine the full model and its various individual paths. In particular, based on the fit between real-life outcomes and those obtained through simulations, these methods may allow us to quantify the strength of the different paths connecting the process variables as well as to evaluate whether additional paths should be included or omitted in the parsimonious model. Such connectionist, computational models have already been successfully applied to predict attitude formation and change (e.g., Van Overwalle & Siebler, 2005) and may prove to be a fruitful alternative method to further validate the IPA.

Conclusion

The main goal of the presented integrative process approach (IPA) was to incorporate the findings of various research lines on decision making with a special focus on how arousal, affect, cognitive ability, and motivation shape information processing and decision making. Most important, the present contribution draws attention to the interrelations between various process variables rather than adopting narrow, one-process explanations. Clearly, the interplay between the different process variables is complex, and the IPA does not claim to explain all mechanisms underlying information processing in decision making. However, by integrating different research lines, the IPA provides a framework to interpret empirical findings from the individual research traditions in a broader perspective and provides a theoretical outline for future research to advance our knowledge on the mechanisms underlying information processing in decision making.

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