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Developing and validating the multidimensional proactive decision-making scale

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ABSTRACT

On the basis of an extensive interdisciplinary literature review proactive decision-making (PDM) is conceptualised as a multidimensional concept. We conduct five studies with over 4000 participants from various countries for developing and validating a theoretically consistent and psychometrically sound scale of PDM. The PDM concept is developed and appropriate items are derived from literature. Six dimensions are conceptualised: the four proactive cognitive skills ‘systematic identification of objectives’, ‘systematic search for information’, ‘systematic identification of alternatives’, and ‘using a decision radar’, and the two proactive personality traits ‘showing initiative’ and ‘striving for improvement’. Using principal component factor analysis and subsequent item analysis as well as confirmatory factor analysis, six conceptually distinct dimensional factors are identified and tested acceptably reliable and valid. Our results are remarkably similar for individuals who are decision-makers, decision analysts, both or none of both with different levels of experience. There is strong evidence that individuals with high scores in a PDM factor, *e.g.* proactive cognitive skills or personality traits, show a significantly higher decision satisfaction. Thus, the PDM scale can be used in future research to analyse other concepts. Furthermore, the scale can be applied, *e.g.* by staff teams to work on OR problems effectively or to inform a decision analyst about the decision behaviour in an organisation.

1. Introduction

> “If I were given one hour to save the planet, I would spend 55 minutes defining the problem and five minutes resolving it.”
> *Albert Einstein*

In the last decades, the methods in Operational Research (OR) made substantial progress. Researchers developed methods, which can be used to “solve problems” about which earlier generations had dreamt. These OR methods have a great positive impact on the quality of individual and organisational decisions. In line with the famous quote from Albert Einstein it is important to spend effort in defining a problem. The more appropriate the problem is defined and structured, the greater the potential for positive impact of OR methods. This paper contributes to skilful problem structuring by providing a new concept concerning proactive decision-making and an empirically validated scale that measures proactive cognitive skills and personality traits to support making better decisions.

Woolley and Pidd (1981, p. 197) described problem structuring as “the process by which the initially presented set of conditions is translated into a set of problems, issues and questions sufficiently well defined to allow specific research action.” In theory and practice, problem structuring methods have gained more and more attention (Franco & Montibeller, 2010; Mingers & Rosenhead, 2001; Tavella & Papadopoulos, 2014). Problem structuring methods (PSM) are described by Rosenhead (2013, p. 1162) as a “broad group of model-based problem handling approaches whose purpose is to assist in the structuring of problems rather than directly to derive a solution.” These methods are most frequently applied by groups and are characterised by participation and interactivity (Rosenhead, 2013).

Franco and Meadows (2007) indicated that McGrath’s (1984) circumplex is the most accepted framework for group decision support, theory, and research. McGrath identifies four basic actions that need to be performed in a decision related meeting: generating, choosing, negotiating, and executing decisions. The main tasks of a group contain generating alternatives (*i.e.* ideas, plans, strategies, *etc.*) and negotiating conflicting preferences. “Within the context of a

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PSM-supported process, groups will engage in information gathering and the designing of strategic options (generate). They will also structure and evaluate the relative advantages and disadvantages of different strategic options before selecting a problem focus and/or a course of action (negotiate)" (Franco & Meadows, 2007, p. 1624). Both generating as well as negotiating are crucial for success. However, we argue that a reasonable result in a generation phase is prerequisite for an effective negotiation phase. Therefore, we are convinced that a focus on the generating tasks is crucial to success.

Many studies recommend that cognitive styles and decision-making styles do have an impact on individual decision-making (*e.g.* Epstein, Pacini, Denes-Raj, & Heier, 1996; Novak & Hoffman, 2009; Scott & Bruce, 1995), and on group decision-making processes (*e.g.* Hough & Ogilvie, 2005; Schwenk, 1995). This applies also for the design, use and acceptance of group decision support systems (*e.g.* Benbasat & Dexter, 1982; Lu, Yu, & Lu, 2001; Taylor, 2004).

As a support for group decision-making Franco and Meadows (2007) emphasise the importance of cognitive style in PSM research and application. They pioneered in systematically analysing the impact of Jung's (1971) theory of psychological types in context of PSM and derive logically from literature eight hypotheses, *e.g.* that "sensing and intuitive individuals will play a lead role during option designing tasks, in comparison to thinking and feeling individuals" (p. 1626). Garfield, Taylor, Dennis, and Satzinger (2001) identified empirically that innovative, radical alternatives are created by intuitive and feeling individuals more often than by sensing and thinking individuals.

To the best of our knowledge, none of the existing psychological tests and scales are suited for explaining the process of "generating" comprehensively. In particular, it is of interest which skills individuals have in the generating phase and how much and why they take initiative. Research on decision-making lacks a psychometrically reliable scale for measuring proactive decision-making. In this paper, we develop a scale that distinguishes four cognitive skills and two personality traits relevant to the generation phase in PSM. Our scale measures proactive cognitive skills derived from value-focused thinking and proactive traits derived from proactive behaviour.

Bateman and Crant (1993) define proactive behaviour as the relatively stable tendency to effect environmental change. The essential characteristic of *proactive behaviour* is that "people can intentionally and directly change their current circumstances, social or nonsocial, including their physical environment" (Bateman & Crant, 1993, p. 104, referring to Buss, 1987). The prototypical proactive personality is relatively unaffected by situational forces and interacts with its environment actively. Individuals classified as reactive, by contrast, are relatively passive and are rather shaped by their environment than shaping it themselves (Parker, Bindl, & Strauss, 2010). Proactive individuals actively search for opportunities, take initiative, and proceed with their actions until they achieve their objectives (Bateman & Crant, 1993). Schwarzer (1999) develops a scale to measure the personality trait *proactive attitude*, which can affect motivations and imply actions. Proactive individuals have a vision and are driven by their values. They follow goals that they think are worth reaching for (Parker et al., 2010; Schwarzer, 1999). Bateman and Crant's *proactive behaviour* and Schwarzer's *proactive attitude* have in common that individuals show initiative and strive for improvements in their lives. Individuals cannot change their personality traits related to decision-making easily (VandenBos, 2007). However, Kirby, Kirby, and Lewis (2002, p. 1542) find empirical evidence that proactivity can be trained by the "development of context specific knowledge and skills".

Making decisions, personal or work-related, is an essential part of everyone's life. However, not everyone and every organisation make good decisions. As it has been postulated and verified empirically, proactive personality traits (*e.g.* Seibert, Crant, & Kraimer, 1999; Thompson, 2005) as well as proactive cognitive skills (Keeney, 1992) can have positive impacts on an individual in decision situations. It can be presumed that PDM enables people to make better decisions with results they are more satisfied with. Thus, we consider PDM to be a relevant concept that is worth being looked at in more detail.

Research in OR focuses on best practices or on developing and improving highly sophisticated methods (*e.g.* Corbett, Overmeer, & Van Wassenhove, 1995). Hämäläinen, Luoma, and Saarinen (2013 , p. 623) indicate the importance of behavioural operational research (BOR) as "the study of behavioural aspects related to the use of […] OR methods in modelling, problem solving and decision support". Lu et al. (2001) state that in OR applications, the personality as well as the communication style of the decision analyst and the decision-maker may have a huge impact. Appropriate tools and methods for eliciting information about the decision analyst and the decision-maker are still needed, in particular in problem structuring, since hardly any behavioural research has been done "on the process itself and on the role of the analyst and problem owner" (Hämäläinen et al., 2013, p. 623). These tools and methods have to be selected "on the basis of the skills, knowledge, personal style and experience of the analyst" (Hämäläinen et al., 2013, p. 624, referring to Ormerod, 2008). We develop a scale to measure an individual's behaviour in decision situations. Measurements on this scale can be used to select effective procedures using OR techniques in consideration of behavioural aspects and to analyse behavioural facets in problem structuring.

In this interdisciplinary paper we explicate PDM as a multidimensional concept that combines aspects of *proactive personality traits* and *proactive cognitive skills* in decision situations. We develop a new PDM scale and test it empirically in order to identify reliable and valid measures. In particular, we pursue four objectives: firstly, PDM is conceptualised, *i.e.* the concept is defined, clarified by its dimensions, and differentiated from other constructs; secondly, the dimensions of PDM are operationalised; thirdly, the *multidimensional PDM scale* is empirically tested and validated in several studies; fourthly, decision satisfaction is explained by PDM.

The paper is organised as follows. In Section 2, we summarise the theoretical foundation of proactive behaviour, decision-making, value-focused thinking, and basic psychological concepts. In Section 3, we conceptualise PDM and derive suitable dimensions from literature. In Sections 4 and 5, we describe the operationalisation of constructs and the methodology. In Sections 6 and 7, we summarise and discuss the results of our empirical studies. In Section 8, we discuss implications for OR, limitations, and further research. In Section 9, we draw our conclusions.

2. Theoretical foundation of proactive decision-making

PDM is based on different disciplines such as psychology, decision theory, and behavioural OR. The term 'proactive' refers to personality traits and cognitive skills. Therefore, PDM is framed by insights into proactive personality traits and decision theories in general, value-focused thinking as well as thinking and decision-making styles in particular.

2.1. Proactive personality traits

Grant and Ashford (2008) point out that proactive behaviour involves acting in advance of future situations. Individuals consider future events in their current decisions with foresight, *i.e.* before they occur. Researchers describe this characteristic using the adjectives 'future-focused', 'anticipatory', and 'forward-looking' (Frese, 2006; Frese & Fay, 2001; Frese, Kring, Soose, & Zempel, 1996; Greenglass, 2002). Proactive behaviour is characterised by the intention of having a "discernible effect on the self and/or the environment" (Grant & Ashford, 2008, p. 9). Proactive individuals are change-oriented and interested in creating a meaningful impact on their environment (Buss, 1987; Diener, Larsen, & Emmons, 1984). Reactive individuals, by contrast, are passive and react to, adapt to, and are constrained by their environment instead of shaping it themselves (Bateman & Crant, 1993). Proactive individuals have a vision and are guided by their values. On the basis of a clear perception of what they want to achieve they derive goals that comply with their vision. Schwarzer (1999), who developed a scale to measure proactive attitudes, points out that individuals' purpose in life is defined by striving for ambitious goals. Parker et al. (2010) emphasise the generation of goals as well as the endeavours to achieve them. Proactive individuals take the initiative in pursuing personal and organisational goals (Frese & Fay, 2001; Roberson, 1990). Proactive individuals "scan for opportunities, show initiative, take action, and persevere until they reach closure by bringing about change" (Bateman & Crant, 1993, p. 105). Proactive behaviour is considered to be relatively stable and cannot be changed easily (Bateman & Crant, 1993). The same is true for proactive attitudes. Habitual behaviour and attitudes are actualised in many different situations and therefore, are called personality traits or personal characteristics. The VandenBos (2007, p. 950) defines a personality trait as "a relatively stable, consistent, and enduring internal characteristic that is inferred from a pattern of behaviours, attitudes, feelings, and habits in the individual". For our research we use the more general term 'personality traits' to cover all of its subsumed aspects. However, Kirby et al. (2002, p. 1542) find empirical evidence that proactivity can be trained by the "development of context-specific knowledge and skills". Therefore, we consider personality traits as well as cognitive skills to be relevant dimensions of PDM.

Referring to proactive behaviour, Seibert et al. (1999) analyse the association with endogenous constructs. They find out that the indicators of career success, *i.e.* the self-reported objective indicator (salary and promotion) as well as a subjective indicator (career satisfaction), correlate positively with proactive behaviour. Crant and Bateman (2000) discover that employees who show proactive behaviour are recognised as charismatic leaders. Furthermore, Thompson (2005) links proactive personality to job performance conceived by superiors. Thus, there is empirical evidence that proactive behaviour may have positive impacts on individuals in different contexts.

2.2. Decision-making and value-focused thinking

Decision-making is the process of making a choice between competing courses of action (von Winterfeldt & Edwards, 1986). It is "a dynamic process: a complex search for information, full of detours, enriched by feedback from casting about in all directions, gathering and discarding information, fuelled by fluctuating uncertainty, indistinct and conflicting concepts – some sharp, some hazy" (Zeleny, 1982, p. 3). Furthermore, decision-making is regarded as a cognitive process of choosing an alternative. Individuals and organisations have only through decisions an impact on their situation (Keeney, 1992). On the basis of normative models of the decision theory, processes can be derived as to how individuals should proceed in order to achieve a maximum of their values, objectives, and well-being (Bell, Raiffa, & Tversky, 1988; Howard, 1988). Furby and Beyth-Marom (1992) summarise five steps of decision-making. First, possible alternatives have to be identified. Second, possible consequences of the alternatives have to be identified. Third, the desirability of these consequences has to be evaluated in terms of achieving one's objectives. Fourth, the likelihood of these consequences has to be assessed. Fifth, the best alternative has to be identified among the generated set of alternatives by combining preferences and uncertainty using certain decision rules.

Howard (1988) emphasises the need to distinguish between decision and outcome. "A good outcome is a future state of the world that we prize relative to other possibilities. A good decision is an action we take that is logically consistent with the alternatives we perceive, the information we have, and the preferences we feel" (Howard, 1988, p. 682). However, because one never perceives all possible alternatives and because uncertainty is associated with our knowledge derived of generally incomplete information, a bad decision can result in a good outcome and *vice versa*. von Winterfeldt and Edwards (1986) conclude that a decision cannot be judged by its outcome. Usually, the outcome is determined by several factors that cannot be controlled by the decision-maker. Thus, the quality of a decision can only be evaluated by the process in the course of which it was made and it has to be evaluated by looking at the stages of the decision process before the outcome occurs (von Winterfeldt & Edwards, 1986). However, across the life span, decision-making skills are related to obtaining good decision outcomes (Bruine de Bruin, Parker, & Fischhoff, 2012).

Furthermore, Howard (1988) introduces seven elements of decision quality. 'Decision framing' deals with the question whether the real problem is addressed and whether it is framed appropriately. 'Informational excellence' refers to the cost-effectiveness of information sources and the gathering of meaningful and reliable information. 'Creativity – significantly different alternatives' implies appropriateness of the effort put into the search for and identification of creative and doable alternatives. 'Clear values' refers to the process of gaining clarity about values and trade-offs. 'Integration and evaluation with logic' requires the use of logically correct reasoning. 'Balance of basis' makes the optimal balance of efforts a subject of discussion, *e.g.* the efforts put into clarifying values, creating and evaluating alternatives. 'Commitment to action' deals with the clarity and straightforwardness that is necessary to communicate and execute a decision.

Keeney (1992) introduces a normative approach to PDM. The paradigm of this way of thinking is that values provide the basis of interest in a decision problem. In this context, values refer to what someone hopes to achieve by decision-making, given a certain (set of) alternative(s). Therefore, values should guide the effort made to solve the problem. Values are explicated through an individual's goals and objectives, which serve as a starting point for the decision-making process. Instead of following the traditional process of identifying a problem, generating alternatives, and defining criteria for the evaluation of outcomes before making a choice, Keeney (1992) suggests that decision-makers seek out decision opportunities proactively. Such decision opportunities could be created either by broadening an existing decision context or by recognising individual objectives that might be improved.

Value-focused thinking provides numerous guidelines using values to support the search for more and better alternatives. The principle is to create alternatives taking account of at least one of the values specified for the decision situation. In other words, people think first of what they desire (themselves) and then of possible alternatives that are useful for reaching the desired objective (Keeney, 1992). Siebert and Keeney (forthcoming) identify that decision-makers are able to list only one third of their potentially relevant alternatives, but significantly more and better when being stimulated with objectives.

2.3. Thinking and decision-making styles

Other relevant approaches to PDM are thinking and decision-making styles. Scott and Bruce (1995, p. 820, based on Driver, 1979; Driver, Brousseau, & Hunsaker, 1990; Harren, 1979) speak of "a habit based propensity to react in a certain way in a specific decision context." Thus, styles are neither of habitual behaviour nor of attitude. The decision-making style here is, on the one hand, influenced by the specific situation and, on the other hand, by a more general term in form of a habitual reaction. Apart from this understanding, we find many other constructs; however, they are not fully compatible with each other. Some deal with observable behaviour, while others refer to internal processes. Some are derived from personality traits (*e.g.* Epstein, 1973), while others are derived from situational aspects (*e.g.* Novak & Hoffman, 2009).

Epstein (1973, 1983, 1985, 1994, 2003) introduce the concept of thinking styles, providing also implications for decision-making. They find out that people use in general two different thinking styles: experiential and rational thinking. Experiential thinking is associative, emotional, of little effort, rapidly implemented but slowly changed, parallel, immediate, outcome-oriented, holistic, preconscious, and passively experienced with the process being opaque to the individual. Rational thinking, by contrast, is logical, based on the cause-and-effect rule, hierarchical, sequential, process-oriented, slowly implemented but quickly changed, of much effort, oriented towards delayed action, conscious, and actively experienced with the individual being aware of and in control of the process (Epstein, 1994, 2003; Kahnemann & Frederick, 2002; Sloman, 1996; Smith & DeCoster, 2000). The Rational–Experiential Inventory (REI) developed by Epstein et al. (1996) has been used to measure individual differences in dispositional tendencies to adopt rational and experiential thinking styles.

In contrast to these dispositional thinking styles, Novak and Hoffman (2009) define a *situation specific thinking style* as the particular thinking style or momentary thinking orientation adopted by a consumer in a specific (decision) situation. As Scott and Bruce (1995) do, they emphasise the situational factors. In recent studies, Novak and Hoffman (2009) have considered situations in order to incorporate the different tasks or activities that consumers may undertake as well as different motivations or orientations that consumers may reveal when they undertake a specific task or activity. The situation specific thinking style may be influenced by the task itself or by the consumer's underlying motive for performing a given task, independently of the task itself (Novak & Hoffman, 2009).

An individual with a rational thinking style will probably use cognitive skills for gaining and processing information. This can be done without being noticed by others; it is also possible that this cognitive approach precipitates observable behaviour. The use of cognitive skills characterises how an individual approaches decision situations. These cognitive skills can be acquired through training and practice (VandenBos, 2007). In this paper, we concretise aspects of rational thinking in decision situations, in particular problem structuring, using four cognitive skills derived from the proactive paradigm of decision-making in general and value-focused thinking in particular.

2.4. Theoretical considerations

Proactivity can be manifested in decision-making by proactive personality traits and a proactive way of thinking. While proactive personality traits are regarded as a stable disposition in decision situations, the proactive way of thinking can be changed more easily by training the related cognitive skills (VandenBos, 2007). The distinction between personality traits and cognitive skills can help explain the results of Kirby et al. (2002)), who have found empirical evidence that proactivity is trainable since cognitive skills can be trained.

It has been verified empirically that proactive personality traits can have positive impacts on an individual in decision situations (Seibert et al., 1999). Although Keeney (1992) postulates positive impacts of a proactive way of thinking, these have not been verified empirically yet. Furthermore, we assume that proactive personality traits and proactive cognitive skills complement each other, for example, reactive individuals who neither take initiative nor strive for improvement will not be motivated to apply their cognitive skills effectively. Similarly, proactive individuals who take initiative and strive for improvement but have low proactive cognitive skills will not be effective in decision-making either. Proactive decision-makers who are characterised by proactive personality traits and high proactive cognitive skills should be most effective in their decision-making. To analyse such hypotheses it is necessary to conceptualise PDM and to create a scale that covers proactive personality traits as well as proactive cognitive skills.

3. Conceptualisation of proactive decision-making

At first, the meaning of PDM is specified. Our working definition evolved over time on the basis of an extensive and thorough literature review and several group discussions with experts from different academic disciplines, and it is to be seen as a consensus. We generally speak of decision-making as being proactive if it is value-/objective-oriented and self-initiated by a foresighted individual who strives for improvement. Alternatives are created systematically. Information on opportunities and threats are gathered systematically, and potential outcomes of an individual's actions are anticipated. In our context, PDM can be characterised by (*proactive*) *personality traits* and the use of (*proactive*) *cognitive skills in decision situations* (see Fig. 1).

In this section, we derive the four dimensions '*systematic identification of objectives*', '*systematic search for information*', '*systematic identification of alternatives*', and "*using a 'decision radar'*" – which represent proactive cognitive skills in decision situations – from decision-making, in particular from the first four of the elements of decision quality (Howard, 1988), and the value-focused thinking framework (Keeney, 1992). Other aspects of cognitive skills, such as the evaluation of alternatives, the final decision, or the implementation of a decision, are not postulated as dimensions since there are no fundamental differences between reactive and proactive decision-making. Individuals can acquire proactive cognitive skills intuitively or by learning methods taught in courses, books, and papers on decision-making. However, even if individuals are experts at using these skills, they still have to apply them. The dimensions '*taking initiative*' and '*striving for improvement*' are related to proactive personality traits. Individuals who do not strive for improvement will have no reason to apply their skills. In addition, even if there is a reason to apply these skills, this person needs to take initiative.

3.1. Dimensions of proactive decision-making

According to Schwarzer (1999) and Keeney (1992), proactive individuals have a vision and are guided by values. On the basis of a clear perception of what they want to achieve they derive goals that are in line with their vision. Their purpose in life is generated by striving for ambitious goals (Schwarzer, 1999). The anticipation and imagination of objectives encourage individuals to pursue these objectives (Locke & Latham, 2002). Objectives are crucial for PDM. They are the basis for systematically creating alternatives, guiding the methodical search for information, and planning decisions (Siebert & Keeney, forthcoming). If individuals are not aware of their objectives in a specific decision situation, they generally cannot be proactive in their decision-making. Therefore, the proactive cognitive skill of '*systematic identification of objectives*' (Objectives) is assumed to be a dimension of PDM.

Reactive and passive individuals do not strive for more ambitious goals or values, but they simply accept the alternatives given in a specific decision situation, even if they are not content with them. Proactive individuals, by contrast, try to create more and better alternatives (Keeney, 1992). As previous research has shown, using objectives for the systematic identification of alternatives results in more and better alternatives (Butler & Scherer, 1997; Gettys, Pliske, Manning, & Casey, 1987; Jungermann, Ulardt, & Hausmann, 1983; Pitz, Sachs, & Heerboth, 1980; Siebert & Keeney, forthcoming). Furthermore, using objectives for the identification of alternatives increases the likelihood that individuals will actually achieve their objectives (Grant & Ashford, 2008, referring to Gollwitzer, 1999; Gollwitzer & Brandstätter, 1997; Gollwitzer & Oettingen, 1998). Training in the use of objectives for the creation of alternatives enhances proactive cognitive skills in creating alternatives. If individuals are not aware of their alternatives in a specific decision situation, they cannot be proactive in decision-making. Therefore, the proactive cognitive skill '*systematic identification of alternatives*' (Alternatives) that takes objectives into account is considered to be a dimension of PDM.

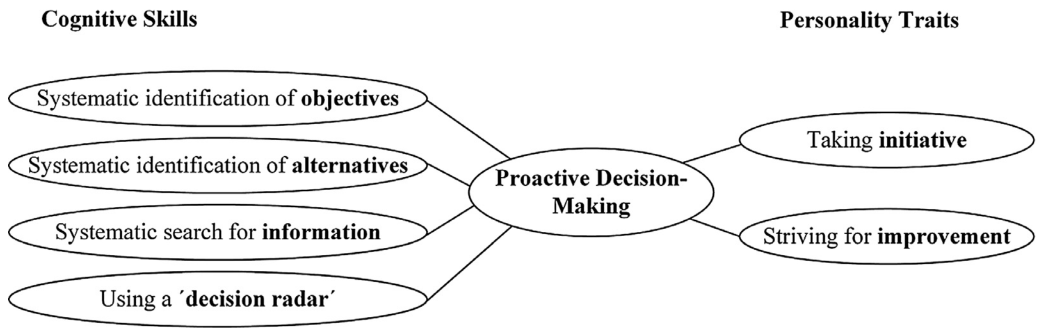

Fig. 1. Dimensions of proactive decision-making (PDM).

The relevant values guide the collection of information in a decision situation (Keeney, 1992). A proactive individual searches actively and purposefully for such information that helps to evaluate alternatives in terms of achieving the relevant values. Reactive individuals only use information that is available or easily accessible and do not gather information systematically (Keeney, 1992). If individuals do not systematically search for relevant information in a specific decision situation, they cannot be proactive in decision-making. Therefore, the proactive cognitive skill '*systematic search for relevant information*' (Information) is regarded as a dimension of PDM.

Proactive individuals are characterised as future-oriented (Frese et al., 1996; Frese & Fay, 2001, 2006; Greenglass, 2002). They act in advance of future situations. This includes not only the anticipation of future events but also the prevention of future problems and active creation of decision opportunities (Frese & Fay, 2001; Weick & Roberts, 1993; Weick, Sutcliffe, & Obstfeld, 1999). The use of objectives for creating decision opportunities oneself may help to generate different and better decision situations. Furthermore, decisions can be planned in a broader context and it can be ensured that the right problems are dealt with (Howard, 1988). The planning of decisions implies continuous involvement with decisions. Individuals have influence on their decisions when they thoroughly consider which decisions are to be made at what time. Instead of dealing with any challenge in life operatively, isolated from other decisions, reactively, and with limited sight from a worm's-eye view, individuals can frame their decisions strategically, taking account of other decisions, proactively, and in a future-oriented manner the bird's-eye view. If individuals are not continuously involved in current and future decisions, they cannot be proactive in their decision-making. Therefore, the proactive cognitive skill '*using a* '*decision radar*'' (Decision Radar) is considered to be dimension of PDM.

Proactive individuals take initiative in decision situations (Bateman & Crant, 1993; Greenglass, 2002). They want to shape their environment actively (Ashford & Black, 1996; Kim, Cable, & Kim, 2005; Saks & Ashford, 1996). If individuals do not take initiative in decision situations, they cannot be proactive in their decision-making. Therefore, the personality trait of '*taking initiative*' (Initiative) is assumed to be a dimension of PDM.

Proactive individuals strive for a "discernible effect on the self and/or the environment" (Grant & Ashford, 2008). They are interested in creating a meaningful impact (Buss, 1987; Diener et al., 1984; Grant & Ashford, 2008). Proactive individuals strive for improvement in decision situations (Iyengar, Wells, & Schwartz, 2006; Parker et al., 2010). If an individual does not strive for improvement in decision situations, they cannot be proactive in their decision-making. Therefore, another dimension of PDM deals with the personality trait of '*striving for improvement*' (Improvement). The personality traits Initiative and Improvement can be regarded as different facets of the commitment to proactive action in decision processes and they result in different degrees of effectiveness of decision processes. As long as individuals do not take initiative, even if they strive for improvement intensely, this will not lead to proactive action in decision processes. Individuals who take high initiative without striving for improvement will not be effective in decision processes either.

3.2. *Proactive decision-making in the context of other constructs*

On the basis of the working definition indicated above, the concept is concretised by its six dimensions. In this section, these six dimensions relevant to PDM are differentiated from related concepts. Firstly, proactive cognitive skills are contrasted with vigilance (Mann, Burnett, Radford, & Ford, 1997), rational decision-making (Scott & Bruce, 1995), and rational thinking (Novak & Hoffman, 2009). Secondly, proactive traits are differentiated from buck-passing and procrastination (Mann et al., 1997) and maximisation (Schwartz et al., 2002).

Using a conflict model, Mann et al. (1997) have found empirical evidence for four basic patterns of coping with stress generated by difficult, potentially threatening decisions: vigilance, buck-passing, procrastination, and hyper-vigilance. Vigilance "posits a decision maker who clarifies objectives, considers alternatives, evaluates consequences, and thinks through how to implement chosen options" (Mann et al., 1997, p. 5). On the basis of this definition, the concept seems closely related to PDM. To illustrate the concept of vigilance in the context of decisions in more detail, we discuss the six items Mann et al. (1997) used to measure vigilance. Some of these items are relatively similar to our proactive cognitive skills. The item "*I try to be clear about my objectives before choosing*" corresponds to Objectives and the item "*I consider how best to carry out a decision*" corresponds to aspects of Decision Radar. Since these two vigilance items may represent two different dimensions of PDM, they appear suitable for our studies. However, regarding the other vigilance items, there are huge differences in orientation and extent. The items "*I try to find out the disadvantages of all alternatives*" and "*When making decisions I like to collect a lot of information"* correspond to Alternatives and Information. But, by using the terms "all" or "a lot of", they put emphasis on the quantity of the information sought instead of its quality, *i.e.* whether the information is decision-relevant. A fifth item "*I like to consider all of the alternatives*" implies that also bad alternatives shall be considered in a decision situation. According to Keeney (1992), this cannot be effective. It is important to systematically create a broad set of good alternatives. The last item "*I take a lot of care before choosing*" seems quite general. In our study, taking intensive care before making a decision is implied by systematically searching for information (Information), identifying objectives (Objectives), and creating alternatives (Alternatives). In summary, it can be concluded that vigilance addresses all of the four proactive cognitive skills. However, the cognitive skills in PDM are rather characterised by purposefulness than the amount of implementation.

Scott and Bruce (1995) identify four decision-making styles that represent the way how individuals usually react in decision situations: a rational decision-making style, an intuitive decision-making style, a dependent decision-making style and an avoidant decision-making style. Rational decision-making basically refers to cognitive skills. It is measured by four items. The first two items "*I make decisions in a logical and systematic way*" and "*My decision making requires careful thought*" generally describe the approach to decision-making. The other two items describe the specific actions that have to be taken to be rational. The item "*I double check my information sources to be sure I have the right facts before making decisions*" corresponds to our dimension Information and the item "*When making a decision, I consider various options in terms of a specific goal*" corresponds to our dimension Alternatives. Even though the rational decision-making style covers aspects of proactive cognitive skills, it remains at a level that is too general to be applicable to our purpose of measuring PDM.

Novak and Hoffman (2009) develop a scale for rational and experimental thinking. Rational thinking is characterised by a thorough search for and logical evaluation of alternatives. This style is measured by items such as "*I reasoned things out carefully*", "*I tackled this task systematically*", "*I figured things out logically*", and "*I was very aware of my thinking process*". These items show that the concept remains abstract and general. The items of the four cognitive skills of PDM, by contrast, provide insight into the specific actions, which have to be taken so that decision-making is considered to be proactive.

Mann et al. (1997) find empirical evidence for procrastination and buck-passing as two aspects of defensive avoidance. The decision-makers try to reduce stress by avoiding conflict through procrastination or transferring responsibility to others. Scott and Bruce (1995) describe the same phenomenon regarding the avoidant and dependent decision-making styles. Frost and Shows (1993) develop a scale to measure compulsive indecisiveness. These constructs provide different explanations as to the question why an individual takes initiative in decision situations. Concerning the concept of PDM, by contrast, it is of importance whether, not why, individuals show initiative in decision-making. Thus, these constructs are exogenous to PDM, especially to the Initiative dimension, and may serve as an explanation for the endogenous construct.

Schwartz et al. (2002) distinguish between maximiser and satisficer referring to the degree to which people select ideal alternatives instead of acceptable alternatives. While maximisers try to find the best alternative and never settle for second best, satisficers tend to choose the first acceptable alternative. The Maximisation Scale focuses on the behaviour in a decision situation. The PDM dimension Improvement, by contrast, refers to striving for improvement in both, a specific and general decision situation. It deals with the question whether individuals are motivated to put effort into decision-making in order to improve their entire current situation.

As mentioned above, proactive personality traits may have positive impacts on individuals in different contexts. Burnett, Mann, and Beswick (1989) identify a modest but significant correlation between dimensions of Flinder's Decision-Making Questionnaire (Mann, 1982), which uses, for example, vigilance, and course satisfaction of students. Since PDM is either based on these constructs or at least related to them, we assume a positive impact of PDM for the user. This assumption is supported by Keeney (1992) who postulates that using value-focused thinking, what implies the use of proactive cognitive skills, improves an individual's quality of life. For proving this assumption, we analyse a consequence construct of PDM and have decided to use the adapted Decision Satisfaction Scale (Fitzsimons, 2000).

4. Operationalisation of constructs

PDM is theoretically presumed to be a (multidimensional) construct, which is not directly observable (DeVellis, 1991). The purpose of this paper was to develop a valid scale being able to measure PDM. Therefore, using the definition of the concept and its dimensions as a basis, indicators had to be found and examined in order to enable indirect self-report measurements.

Since PDM was an innovative construct, operationalisation had to consider the adaption of reliable and valid items from previous (related) concepts that had already been tested in other studies, which were as closely related as possible, however in different contexts; furthermore, it had to consider the creation of completely new items that represent the content of the presumed dimensions (Netemeyer, Bearden, & Sharma, 2003; Hair, Anderson, Tatham, & Black, 2010). Original items that did not fit perfectly were adapted to our context. Concerning dimensions for which we did not find an item in literature, we derived new items from theory. Those items were the result of several revisions by individual members of our research team and group discussions that reflect the agreement of the researchers and experts involved. Each item was translated by native speakers from English into German and *vice versa* to ensure content validity. The original, adapted, and newly created items are listed in Table A1 (Electronic Appendix). All derivations are documented.

To ensure consistency, reflective specified multiple-item-measures were operationalised for each construct dimension (Bollen, 1989). In terms of wording, although some similarity among items was intended to tap the domain, items were phrased simple, straightforward, and non-redundant, *i.e.* with a certain degree of variety to express the amplitude of each construct dimension (Netemeyer et al., 2003, p. 57). However, this might interfere with some reliability and validity criteria, since part of the variation is due to the wider formulation of the items. After analysing the data of the pre-study, some items had to be eliminated for reliability reasons and new items were added.

Since we were interested in the relationship between PDM and other constructs, Decision Satisfaction was operationalised by choosing appropriate items from a short version of the Decision Satisfaction Scale (Fitzsimons, 2000) that we adapted.

5. Methodology

At the exploratory stage, the construction of an experimental item pool was useful in order to explore the actual dimensions (pre-study) and to find reliable and valid measures. Multiple phases of data collections were processed at the confirmatory stage (main studies) including additional items for refinement and validations of the PDM construct and its dimensions.

A questionnaire was designed and five surveys with independent samples were conducted. The questionnaire was piloted and discussed with experts before data collection in the pre-study. The model's and item's goodness (of fit) need to be evaluated (Churchill, 1979). The questionnaire was modified for the main studies. More items were tested and retested within this scale development process (*cf.* Netemeyer et al., 2003).

The participants were asked to evaluate PDM statements on a 7-point Likert scale ranging from (1) 'disagree very strongly' to (7) 'agree very strongly', also providing an 'I don't know'-option and to evaluate their satisfaction on an intensity scale from 0 (extremely unsatisfied) to 10 (extremely satisfied). The first two surveys were conducted in German and data were collected by paper-and-pencil. Almost all students participated at the beginning of a lecture. The third, fourth, and fifth survey were conducted in English and data were collected by establishing an online survey in NovoEd, an online education platform collaborating with well-reputed universities in the USA. The response rates were 28 percent, 27 percent, and 22 percent.

The data analysis during the scale development was guided by classical test theory. Factor analyses were employed to assess the dimensionality, reliability, and validity of the PDM instrument. Exploratory factor analyses (EFA, principal component factoring in IBM SPSS with varimax rotation) were used in both, the pre-study and main study I (initial testing of scale, exploring of multidimensionality and judging of measurement items). As recommended by Netemeyer et al. (2003, p. 149), we employed "EFA and item analyses to trim/retain items for the final form of a scale." The factor structure (components) was proven to be highly reliable at the end of the item selection process (eigenvalues, scree tests, total variance explained, communalities, Cronbach's alphas, and item-to-total correlations are used to explore the factors; according to Fabrigar, Wegener, MacCallum, & Strahan, 1999). In addition, a covariance-based confirmatory factor analysis (CFA) in IBM AMOS, which was part of the main studies (I and II a–c), served for confirming dimensionality and reliability as well as for further validation of the previously identified construct structure and measures. The goodness-of-fit was tested by the Root Mean Square Error of Approximation (RMSEA $\leq$ .08), chi square degrees of freedom ratio (X^2/d.f.), Standardised Root Mean Residual (SRMR $\leq$ .08), Normed Fit Index (NFI $\geq$ .9), Tucker Lewis Index (TLI $\geq$ .9), Comparative Fit Index (CFI $\geq$ .9), and Akaike's Information Criterion (AIC). Fit statistics were evaluated according to the thresholds recommended by Akaike (1987), Browne and Cudeck (1993), Homburg and Baumgartner (1995), Hu and Bentler (1999), and Arbuckle (2008).

In main study I (refining the scale), reliability as well as construct validity were tested by composite reliability (Nunnally, 1978), cross-loadings between different construct dimensions and chi-square difference tests (Anderson & Gerbing, 1988; Bagozzi & Phillips, 1982; Jöreskog, 1971). In main studies II (finalising the scale), reliability as well as convergent and discriminant validity were gauged by composite reliability (CR $\geq$ .6, Bagozzi & Yi, 1988), average variance extracted (AVE) and the criterion established by Fornell and Larcker (1981). Thus, the squared correlations between constructs – expressed by the maximum shared variance (MSV) – should be lower than their corresponding AVE. Regarding the latter "[f]or newly developed scales, values near the .5 threshold (>.45) seem reasonable" (Netemeyer et al., 2003, p. 153).

Finally, structural equations modelling (main study II a–c) was used to explain Decision Satisfaction (endogenous construct) by the dimensions of PDM (exogenous construct) and gauge the nomological validity. The inclusion of Decision Satisfaction (DSA) in our study as a relevant outcome of PDM helped to better understand the influence of each of the dimensions. It provided further information on the potential effects of PDM and hypotheses for future research can be derived. Applying these analyses multicollinearity among the PDM dimensions was tested by detecting variance inflation factors (VIF, Hair et al., 2010; O'Brien, 2007). Furthermore, independent two-sided *t*-tests were applied to prove the significance of differences between decision-makers' degree of proactivity regarding their DSA.

All the PDM construct dimensions as well as the DSA construct were measured at the same time and must be measured appropriately by the subjects' self-evaluations, since solely each individual decision-maker can assess and report their own cognitive skills and personality traits as well as their satisfaction with decisions, *i.e.* obtainment of data from different sources or measurement in different contexts was not applicable in our surveys. As a consequence, common method bias may be an issue (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Podsakoff & Organ, 1986). This was considered a priori during the design of our studies and data collections (MacKenzie & Podsakoff, 2012), *e.g.* by separating predictor (PDM) and criterion (DSA) variables in different blocks of the questionnaire, relatively low complexity and short length of the surveys, emphasis that there were no right or wrong answers, provision of an "I don't know"-option, limited reverse scoring, application of different scale types for dependent and independent variables, voluntary participation, and protecting respondent anonymity. Common method bias was further addressed post hoc by applying Harman's single factor test (Podsakoff et al., 2003).

6. Pre-study

The pre-study pursued our third objective of empirically testing the proactive decision-making (PDM) scale for the first time. This involved the empirical exploration of the construct's dimensionality as well as the examination of its measures' (new and adapted items) reliability and validity. In this first study, the six potential dimensions of PDM were tested: *systematic identification of objectives*, *systematic search for information*, *systematic identification of alternatives, using a* '*decision radar*', *taking initiative*, and *striving for improvement.*

Data were collected in November 2013. The participants were full-time master students enrolled in business-related courses at a German university. Overall, 188 participants, 97 males and 73 females on average 23.2 years old, completed the questionnaire and needed an average time of approximately 10 minutes. The responses of those 18 participants who were not German native speakers were excluded from the results, since their responses showed many inconsistencies in the data.

An exploratory factor analysis with 19 items that represent the definition of the PDM was conducted. The principal component analysis extracted five factors with eigenvalues over 1. The rotated five-factor solution explained 61.7 percent of the total variance. We iteratively removed items depending on their communalities and factor loadings and evaluated the consistency of each factor. In particular, items Ini_2 and Alt_6 were deleted because of communalities below .5. Items Rad_1, Rad_2, and Rad_3 were eliminated due to low factor loadings.

As a result, the reduced 16-item-scale consisted of reliable and valid measures. The five factors explained 66.1 percent of the total variance. The Kaiser–Meyer–Olkin value amounted to .759 and was considered to be middling, *i.e.* it served as an indication that the factor analysis was useful for these variables. Factor loadings varied between .581 and .836 (see Table 1). No item loaded more than .4 on another factor. Thus, the analysis of the factor loadings revealed that all items loaded high on the five dimensions.

Each factor represents one dimension of PDM. The explored factors can be interpreted as the following dimensions: Objectives, Alternatives, Information, Initiative, and Improvement. Consequently, five out of six postulated dimensions were identified through explorative data analyses. Since all of the items that correspond to *using a 'decision radar'* were eliminated, we could not verify the assumed sixth dimension of PDM. For this reason, 'decision radar' as a potential dimension was operationalised by new items. Although the factor loadings of Information were acceptable, the consistency of the factor (Cronbach's alpha) was very low. Thus, we decided to use different indicators in the main studies.

7. Main studies

The main studies aimed at empirically testing the further developed and optimised Proactive Decision-Making (PDM) scale (third objective) by means of larger samples and at explaining Decision Satisfaction (DSA) by the dimensions of PDM (fourth objective).

7.1. Main study I

The participants in main study I were full-time bachelor students enrolled in business-related courses at a German university. Overall, 567 participants with an average age of 20.53 years completed the study within approximately 10 minutes. Three hundred eleven male and 243 female students participated. Thirteen participants did not reveal their gender.

The EFA extracted six factors (components) with eigenvalues over 1. Again, Cronbach's alpha and item-to-scale correlations were examined. Unreliable items were iteratively eliminated and the scale was

Table 1
Factor loadings and reliability measures (pre-study).

Factors/constructs/dimensions	Indicators	Reliability analysis		
		Factor loadings	Cronbach's alpha	(corrected) Item-to-scale correlation
Objectives	Obj_1	.691	.766	.550
	Obj_2	.836		.635
	Obj_3	.806		.614
Information	Inf_1	.759	.325	.387
	Inf_2	.619		.326
	Inf_3	.581		−.082
Alternatives	Alt_1	.655	.714	.498
	Alt_2	.716		.366
	Alt_3	.720		.585
	Alt_4	.705		.579
Initiative	Ini_1	−.775	.762	.574
	Ini_3	−.759		.641
	Ini_4	−.772		.594
Improvement	Imp_1	.693	.796	.624
	Imp_2	.805		.656
	Imp_3	.784		.639

reduced until it proved acceptably valid. During this process, items Imp_4, Alt_5, Ini_4, Inf_5, Obj_4, Ini_2, and Rad_1 were removed because of low communalities or low factor loadings. Concerning the dimensions Initiative ($\alpha = .625$), Objectives ($\alpha = .714$), and Alternatives ($\alpha = .759$) Cronbach's alpha could not be improved by extending or eliminating one of the items. We eliminated item Inf_1 of dimension Information because of its low item-to-scale correlation to increase Cronbach's alpha from .704 to .735. We included item Rad_1 of dimension Decision Radar because Cronbach's alpha increased from .706 to .742. As to the dimension Improvement the elimination of item Imp_1 increased Cronbach's alpha from .800 to .840. However, Imp_1 remained because each factor should be measured by at least three items (Bollen, 1989) and the item tapped the construct domain and was non-redundant.

Again, the remaining 21 items yielded six factors (components) with eigenvalues over 1. The Kaiser–Meyer–Olkin value amounted to .853 and was considered meritorious, *i.e.* principal component factor analysis was applicable to these variables. The six-factor solution using 21 items explained 62.6 percent of the total variance. The rotated component matrix is illustrated in Table 2. Only Obj_2, Alt_4, and Inf_3 (among proactive cognitive skills) loaded more than .3 on a second factor. However, no item loaded more than .4 on a second factor.

The factor Objectives implies the active and systematic identification of relevant objectives in a decision situation resulting in awareness of these. Information deals with the active and systematic search for information. Alternatives refers to the systematic and purposeful identification of promising alternatives using objectives. Decision Radar implies future-orientation and purposeful planning of decisions. Initiative describes whether individuals take initiative and change their environment. It has to be noted that concerning the factor Initiative only reversely formulated, reactive items remained. Thus, the items correlated negatively with their factor. However, scores were recoded for further analyses to simplify interpretations of the six factors. Improvements deals with an individual's inherent desire to improve their situation.

The identified factors were confirmed in a CFA, in which items loaded significantly and highest on their corresponding constructs (dimensional factors). Due to relatively low factor loadings and reliabilities, items Alt_1, Rad_1 and Rad_4 were removed from the model. The factor loadings of the remaining 18 items were predominantly within the desired range of .6 and .9 (Netemeyer et al., 2003, p. 153). Although indicator reliabilities of Alt_2, Rad_5 and Ini_3 were a bit low, all values of composite reliabilities were acceptable and above the threshold of .6 (Bagozzi & Yi, 1988). A certain number of tested items remained, reflecting each dimension appropriately.

The four cognitive skills related factors correlated with .476 to .644 among each other and the two personality traits related factors with .307. Intercorrelations among all six PDM factors across cognitive skills and personality traits ranged between .259 and .465. Discriminant validity was further tested by single degree of freedom tests. The chi-square differences between one- and two-factor models for each possible pair of measures as well as the entire model (PDM) were all significantly above the threshold of 3.841 (Jöreskog, 1971; Anderson & Gerbing, 1988). Thus, support for a sufficient level of discriminant validity was provided in this study.

Overall, our PDM model showed a very good fit of the data to the theoretically derived model structure (Table 2). The global fit indices (RMSEA, X^2/d.f., TLI, CFI, SRMR) were within their thresholds; only the NFI was marginally lower than the recommended criterion, but rounded up to .9. Thus, the 6-factor model structure and its measures fit well and were used to further evaluate the PDM scale. Construct validity was assessed using multiple sources of data in main study II.

7.2. Main study II

The participants in main study II (a), (b) and (c) were individuals who have enrolled in one of NovoEd's online courses *DQ 101: Introduction to Decision Quality* by Carl Spetzler. We had independent samples of three of these courses in 2014. The PDM surveys were administered and promoted by NovoEd before each course started. Overall, 3872 participants, one third female and two thirds male, completed the surveys. The participants came from 132 countries, the majority originated in the USA. They mainly worked in industries such as banking/financial services/insurance, education, energy/utilities/chemical, manufacturing, technology, or transportation. Different groups of age were well represented: 39 percent were between 18 and 30 years old, 31 percent were between 31 and 40 years old, and 30 percent were older than 40 years. After data screening, preparation and elimination of cases with missing values a total of 3307 cases remained; 1245 in sample (a), 1071 in sample (b), and 991 in sample (c). Most of the participants had substantial experience in dealing with decision-making professionally: 31 percent more than 10 years, 18 percent between 5 and 10 years, 32 percent between 1 and 5 years, and only 19 percent less than 1 year. Furthermore, 48 percent were both decision-maker and decision analyst, 15 percent were decision-maker, 23 percent were decision analyst, and only 14 percent were none of both.

We used CFA to further validate the hypothesised model structure of the multidimensional construct as well as measures. Due to low factor loadings and high crossloadings with other factors two items Alt_4 and Rad_2 were removed and 19 items remained for further

Table 2
Factor loadings and reliability measures (main study I).

Factors/constructs/dimensions	Exploratory factor analysis		Reliability analysis		Confirmatory factor analysis			
	Indicators	Factor loadings	Cronbach's alpha	(corrected) Item-to-scale correlation	Standardised factor loading	Significance factor loading	Indicator reliability	Composite reliability
Objectives	Obj_1	.770	.714	.529	.688	***	.473	.717
	Obj_2	.723		.571	.676	***	.457	
	Obj_3	.703		.500	.667	***	.445	
Information	Inf_2	.761	.735	.504	.619	***	.383	.751
	Inf_3	.739		.615	.842	***	.709	
	Inf_4	.756		.576	.653	***	.426	
Alternatives	Alt_1	.730	.759	.467	–		–	.752
	Alt_2	.588		.566	.617	***	.381	
	Alt_3	.713		.603	.663	***	.440	
	Alt_4	.510		.596	.837	***	.701	
Decision Radar	Rad_1	.603	.742	.496	–		–	.668
	RAd_2	.660		.539	.649	***	.421	
	Rad_3	.659		.510	.673	***	.453	
	Rad_4	.644		.426	–		–	
	Rad_5	.741		.580	.578	***	.334	
Initiative	Ini_1	−.782	.625	.464	.679	***	.461	.666
	Ini_3	−.764		.422	.580	***	.336	
	Ini_5	−.697		.418	.634	***	.402	
Improvement	Imp_1	.731	.800	.535	.625	***	.391	.825
	Imp_2	.872		.717	.877	***	.769	
	Imp_3	.835		.692	.828	***	.686	
Overall model fit					RMSEA = .050, X^2/d.f. = 2.035, NFI = .899, TLI = .930, CFI = .945, SRMR = .045			

*** significance level: .001.

Table 3
Factor loadings, reliability and validity measures (main study II).

Factors/constructs/dimensions	Indicators	CFA main study II (a), $N = 1245$				CFA main study II (b), $N = 1071$				CFA main study II (c), $N = 991$			
		Standardised factor loading	CR	AVE	MSV	Standardised factor loading	CR	AVE	MSV	Standardised factor loading	CR	AVE	MSV
Objectives	Obj_1	.804	.835	.628	.697	.836	.847	.649	.661	.824	.838	.634	.635
	Obj_2	.813				.823				.823			
	Obj_3	.760				.755				.738			
Information	Inf_2	.737	.824	.610	.697	.698	.787	.552	.716	.708	.820	.604	.704
	Inf_3	.837				.789				.847			
	Inf_4	.765				.739				.770			
Alternatives	Alt_1	.782	.846	.646	.605	.748	.845	.646	.694	.765	.852	.658	.637
	Alt_2	.831				.849				.858			
	Alt_3	.798				.811				.808			
Decision Radar	Rad_1	.710	.824	.540	.689	.712	.822	.537	.716	.732	.837	.563	.704
	Rad_3	.704				.674				.700			
	Rad_4	.756				.774				.796			
	Rad_5	.766				.766				.770			
Initiative	Ini_1	.803	.671	.509	.240	.773	.641	.476	.085	.813	.683	.523	.171
	Ini_3	.611				.595				.621			
	Ini_5	.719				.657				.674			
Improvement	Imp_1	.790	.838	.634	.328	.807	.832	.625	.359	.783	.831	.623	.295
	Imp_2	.877				.867				.863			
	Imp_3	.713				.688				.715			
Overall model fit		RMSEA = .068, X^2/d.f. = 6.690, NFI = .928, TLI =.923, CFI = .938, SRMR = .057				RMSEA = .070, X^2/d.f. = 6.680, NFI = .919, TLI = .914, CFI = .931, SRMR = .058				RMSEA = .062, X^2/d.f. = 4.745, NFI = .936, TLI = .936, CFI = .948, SRMR = .051			

analyses. Except for Ini_3 (.595) in study (b) all factor loadings were above .6 and below .9 (see Table 3).

In all three studies the items loaded significantly on the intended factors. Across the three samples, the composite reliabilities (CR) were good; compared to the other factors the reliability of Initiative was lower but acceptable. Evaluated on basis of AVE greater than .45 for newly developed scales (Netemeyer et al., 2003), evidence for convergent validity existed for all six PDM factors. However, the four factors related to cognitive skills, *i.e.* Objectives, Information, Alternatives, and Radar, faced discriminant validity issues that had to be considered in further analyses. They had relatively high intercorrelations (between .732 and .830 on average across the three samples) resulting in high MSV values that in main part were above their AVE values. Intercorrelations among Initiative and Improvement (.260 on average) as well as between cognitive skills factors and personality traits factors (between .281 and .572 on average) supported a sufficient distinctiveness. Indeed, the average shared variance of each factor was below the AVE and the chi-square differences were all significant as well. Regarding the overall goodness, adequate levels of model fit for RMSEA, NFI, TLI, CFI, and SRMR were found. Only the X^2/d.f. ratios were relatively high due to the large sample sizes.

The six dimensions represent different facets of PDM. Objectives, Information, Alternatives, and Radar all measure cognitive skills. Since proactive decision-makers who are cognitively skilled usually define and follow their objectives, search for information, evaluate alternatives and monitor their 'decision radar', it is apparent that these

Table 4
Goodness-of-fit indices for sub groups (main study II).

Groups	N	RMSEA	X^2/d.f.	NFI	TLI	CFI	SRMR
Neither decision-maker, nor decision analyst	448	.064	2.815	.916	.930	.944	.050
Decision-maker	513	.072	3.688	.917	.923	.938	.065
Decision analyst	774	.062	3.935	.924	.927	.942	.057
Decision-maker and decision analyst	1572	.069	8.425	.931	.913	.931	.059
Experience in decision-making less1 year	631	.061	3.366	.931	.938	.950	.052
Experience between 1 and 5 years	1062	.068	5.263	.932	.930	.944	.051
Experience between 5 and 10 years	576	.074	4.123	.902	.924	.923	.074
Experience more than 10 years	1038	.071	4.471	.918	.912	.930	.060

Table 5
Goodness-of-fit indices and squared multiple correlations for the four substantive models (main study II).

Model		RMSEA	X^2/d.f.	NFI	TLI	CFI	SRMR	AIC	R^2
Model 1	**Six 1st order factors**: objectives, information, alternatives, radar, initiative, and improvement	.059	12.481	.944	.937	.948	.050	2476	.305
Model 2	**One 2nd order factor** (cognitive skills): objectives, information, alternatives, and radar; **Two 1st order factors**: initiative and improvement	.060	12.868	.939	.934	.944	.054	2669	.483
Model 3	**One 2nd order factor** (PDM): objectives, information, alternatives, radar, initiative and improvement	.060	13.050	.937	.933	.942	.056	2738	.479
Model 4	**One 3rd order factor** (PDM): cognitive skills, initiative and improvement. **One 2nd order factor** (cognitive skills): objectives, information, alternatives, and radar	.061	13.109	.937	.933	.942	.056	2739	.466

Table 6
Fornell–Larcker criterion (AVE on diagonal, correlations and squared correlations between constructs above and below diagonal), composite reliability and standardised path coefficients for model 1 (main study II).

	Obj	Inf	Alt	Rad	Ini	Imp	DSA	CR	Path coefficients
Objectives	.636	.816	.733	.809	.343	.572	.605	.840	.215***
Information	.666	.590	.791	.830	.295	.536	.575	.811	.057*
Alternatives	.537	.626	.649	.784	.405	.538	.655	.847	.375***
Radar	.654	.689	.615	.546	.281	.514	.642	.828	.304***
Initiative	.118	.087	.164	.079	.499	.260	.352	.662	.145***
Improvement	.327	.287	.289	.264	.068	.628	.349	.834	−.044*
DSA	.366	.331	.429	.412	.124	.122	.775	.912	

* significance level: .05.
*** significance level: .001.

dimensions can be highly intercorrelated. Proactive cognitive skills may account for their substantial intercorrelations. Both Initiative and Improvement represent personality traits. However, even less initiative decision-makers may strive for improvement and *vice versa*. An intercorrelation of these two (separate) dimensions may only be low. The same is true for intercorrelations across skills and traits.

A comparison of the goodness-of-fit statistics of different groups of professionals and experience levels revealed that the model structure was relatively stable across these groups showing similar results (see Table 4). However, the model fit better for decision analysts and less experienced subjects. The pattern of factor loadings was very similar across all groups (see Electronic Appendix, Tables A2 and A3). Thus, measurement and factorial invariance was found.

7.3. Explanation of decision satisfaction

By analysing the structural relationships between PDM and other concepts the nomological validity was tested. PDM was considered as an antecedent of decision satisfaction (DSA). Since DSA was measured with an adapted short scale introduced by Fitzsimons (2000), we ensured validity and reliability by another factor analysis. By applying the same procedure as described above, one factor was formed with high factor loadings among three items (Dsa_p, Dsa_d, Dsa_s).

In terms of the relationships between the six PDM dimensions, one has to consider PDM as being a higher order construct (Hair et al., 2010), *i.e.* PDM as a second order or even a third order construct comprising cognitive skills and personality traits as second order constructs. Thus, in the context of other concepts one has to decide which PDM dimensions should be included in which order. We postulated four substantive first and higher order models and examined their impact on DSA in a structural equations model (SEM). The SEM was carried out on the total data of main study II ($N = 3307$). The goodness-of-fit indices for the four models and the squared multiple correlations coefficients (R^2) of decision satisfaction are presented in Table 5.

Although the four competing models all fit adequately to the empirical data (again X^2/d.f. ratios were high due to the large sample size), model 1 had the best overall fit (RMSEA = .059), followed by model 2 and 3 (RMSEA = .060). A comparison on basis of AIC suggested that model 1 should be the preferred model, followed by model 2.

Multicollinearity should not be an issue when explaining DSA since the PDM factors had initially been extracted in an EFA, the reliability of the measures as well as the explanatory capacity were high and sample size was large (Grewal, Cote, & Baumgartner, 2004). But to ensure low multicollinearity, it was tested in linear regression analysis explicitly. The VIF values ranged from 1.121 to 2.553, *i.e.* all values were close to 1 and clearly below the threshold of 3 (Hair et al., 2010; O'Brien, 2007).

The six PDM factors and the DSA factor were intercorrelated (see Table 6 for model 1). However, with a composite reliability of .912, an AVE of .775 and a MSV of .429 the DSA construct was reliable, convergent valid and discriminated sufficiently from PDM, since support for the Fornell–Larcker criterion was provided for DSA in relation to the six PDM factors.

In particular, the four cognitive skills factors were highly intercorrelated, which was considered in model 2 and model 4, but not in model 3. However, model 4 is very abstract and its interpretation in the context of other concepts is complex. Regarding the presented higher order models 2–4 model 2 provides the lowest AIC value and might be an applicable variant for explaining DSA or other concepts,

Table 7
Fornell-Larcker criterion (AVE on diagonal, correlations and squared correlations between constructs above and below the diagonal), composite reliability and standardised path coefficients for model 2 (main study II).

	Cognitive Skills	Initiative	Improvement	DSA	CR	Path coefficients
Skills	.798	.369	.602	.694	.922	.679***
Initiative	.136	.490	.258	.352	.740	.144***
Improvement	.362	.067	.628	.347	.834	−.033*
DSA	.482	.124	.120	.776	.912	

* significance level: .05.
*** significance level: .001.

when a conceptually distinct scale with acceptable internal consistency is needed. In the following we highlight model 2. Regarding reliability and validity of Cognitive Skills as a second order construct as well as of Initiative, Improvement and Decision Satisfaction as first order constructs, high levels of composite reliability as well as convergent and discriminant validity were achieved (see Table 7; for detailed results on model 2 regarding different groups of professionals and experience levels see Electronic Appendix, Tables A5 and A6).

Whereas model 1 explained about 30.5 percent of the DSA construct's variance, model 2 explained about 48.3 percent of DSA. Both models were supported by theory as was conceptualised in Section 3. However, model 1 allows for more detailed analyses of the influences on DSA. Overall, regarding model 1 the standardised path coefficients of all six factors were significant. Alternatives ($\gamma = .375$) and Radar ($\gamma = .304$) had the strongest influence on DSA. Information and Improvement had only weak impacts. Regarding model 2 Cognitive Skills as a second order construct had the largest impact on DSA ($\gamma = .679$). The influences of Initiative and Improvement were similar as in model 1.

The explained variances of 30.5 percent (model 1) and 48.3 percent (model 2) respectively were moderate but acceptable since DSA was only explained by one concept in this case, *i.e.* PDM. Considering the uncertainty in decision-making and the distinction between a decision and its outcome (Howard, 1988) as well as numerous possible antecedents of satisfaction with one's decision in addition to PDM, such as anticipated regret, evaluation costs, choice confidence (Heitmann, Lehmann, & Herrmann, 2007), *etc.*, and the distorted perception of a decision, PDM represented a relevant predictor with significant explanatory power.

The average DSA of 814 participants with high Improvement (mean: 6.584, standard deviation 1.484) was significantly better than of 2493 participants with low Improvement (5.682, 1.569). The average DSA of 1032 participants with high Initiative (6.910, 1.440) was significantly better than of 2275 participants with low Initiative (6.114, 1.541). The average DSA of 1890 participants with high Cognitive Skills (7.015, 1.280) was significantly better than of 1417 participants with low cognitive skills (5.492, 1.459). All differences were significant on a .001-level (*t*-statistic). We concluded that Initiative, Improvement, and proactive Cognitive Skills were necessary to achieve a high Decision Satisfaction.

Although procedural controls of method bias had been implemented ad hoc, common method variance was gauged statistically post hoc. By extracting a single factor in an unrotated EFA including all manifest variables of PDM and DSA, in both main studies considerably less than 50 percent of the variance was explained by a single factor. Thus, common method bias had been sufficiently controlled and did not appear to be problematic in these studies (Podsakoff et al., 2003). In main study II the common method variance was a bit higher than in main study I. The reason could be that people respond differently online than in a paper-and-pencil survey.

8. Implications for OR, limitations, and further research

The construct structure of PDM is composed of six dimensions/factors (components). Acceptably reliable items ensuring valid measurements were created for the entire construct and each dimension/factor. The created and tested items serve as proxies for the construct and its dimensions and are well applicable in research and daily business. Nevertheless, the contributions include that more measurement work is needed on the relatively low AVE measures. Achieving high levels of convergent and discriminant validity among dimensions of a multidimensional construct is a long term objective. Each dimension of the PDM construct should be re-evaluated constantly and could be highlighted in separate studies in order to generate a high number of consistent multi-item-measures as well as single-item-measures that discriminate adequately from other PDM dimensions as well as different constructs. Hierarchical confirmatory factor analysis multi-trait multi-method approach could be used to explore the validity of the PDM as higher order construct in future studies (Guo, Aveyard, Fielding, & Sutton, 2008).

We suggested two related models, a first order only model, treating each of the six PDM factors individually, and a second order model, comprising the highly intercorrelated cognitive skills factors in addition to the two separate personality traits factors. Since both models exhibit a similar goodness-of-fit they can be applied depending on the specific research context. Our results are remarkably similar for individuals who are decision-makers, decision analysts, both or none of both with different levels of experience. However, our scale needs to be further tested for different populations.

The PDM scale, as any other self-report scale, has the limitation of self-evaluations. Some people may argue that decision processes are mainly inner psychological processes. However, some parts of the process are often observable. Therefore, it may be interesting to analyse if the results of self-estimation by means of PDM and observations by other people (observers, superiors, or colleagues) are similar. Here, we can expect a high correlation. Thus, the multidimensional PDM scale could be further validated by applying multiple methods regarding the correlation between the decision-makers' self-evaluations of multi-item measures on the one hand and third party observations, responses, or ratings on single-item measures using a different scale on the other hand (Netemeyer et al., 2003, p. 80). Involving various data sources as well as data collections in multiple points in time also contributes to control common method bias.

The level of PDM can be used to group individuals. Individuals can be classified and described as being proactive or reactive decision-makers. In particular, PDM can be used for explanation and prediction purposes in studies dealing with individuals' satisfaction with their decision-making or actual decisions. Especially satisfaction is a multi-attributive construct, which is determined by a variety of different factors. Many conceptual papers, empirical research studies, and experiments regard satisfaction as a mediator variable in cause-and-effect modelling. In our study, we found empirical evidence that PDM has a significant influence on decision satisfaction. Although decision satisfaction is already explained moderately by PDM, further research is required to identify other concepts and to analyse their influence on decision satisfaction in combination with PDM. In future, the consideration of PDM will enable academic, business, OR and marketing researchers as well as psychologists to analyse individuals' satisfaction as a predictor of behaviour in more detail. PDM should be validated as a focal construct in a nomological network with different antecedents and consequences as well as potential moderators and mediators (Edwards, 2001; MacKenzie, Podsakoff, & Podsakoff, 2011). We follow Calder, Phillips, and Tybout (1983 , p. 113) argument that “[t]heory must be the driving force in designing theory-testing research” and thus a theory can only be supported by convergence, discriminant and external validity. However, the latter is deemed as less important. Apart from concepts that are potentially influenced by PDM (directly and indirectly), future research should also discuss and analyse the antecedents of PDM, especially of each dimension. In this regard, research questions may focus on the reasons why individuals are proactive in their decision-making. As to that, psychological questions could be analysed. Each individual has a long learning history (*e.g.* operant conditioning processes and learning by models). Some of these results will influence their decision-making. In accordance with previous literature (*e.g.* VandenBos, 2007), we suggest that the cognitive skills can be trained or learned more easily compared to personality traits. This presumption should be verified empirically in a study in which participants are given the PDM questionnaire twice, *i.e.* before and after a course on decision-making. On average, the scores in cognitive skills should increase while the scores in personality traits should remain stable. The results could be used to optimise the course on decision-making in respect to increasing the participants' cognitive skills even more.

Franco and Meadows (2007) emphasise the importance of cognitive style in PSM research and application. The PDM scale can be applied in all research questions in which other scales are used to gain more insights about the cognitive skills and personality traits in decision-making and problem structuring. Experiments on hypotheses derived by Franco and Meadows (2007) and empirical findings (Garfield et al., 2001) regarding the impact of Jung's theory of psychological types in context of PSM could be complemented by a scale that covers in particular cognitive skills and personality traits that are relevant in the generating phase in problem structuring. For example, Garfield et al. (2001) found empirical evidence that innovative, radical alternatives are created more often by intuitive and feeling individuals than by sensing and thinking individuals. The results of Siebert and Keeney (2013) indicate that using objectives enhances the quality and quantity of created alternatives. Proactive individuals use objectives to create alternatives (Keeney, 1992). The PDM scale allows identifying proactive individuals. Therefore, this scale may help to understand why intuitive and feeling individuals are more productive in creating alternatives. Another example is that the PDM scale may be useful to explain individual differences and conceptual modelling task performance (Dhillon & Dasgupta, 2011).

We have already discussed the aspect that PDM may be linked to procrastination and buck-passing (defensive avoidance, Mann et al., 1997; avoidant and dependent decision-making styles, Scott & Bruce, 1995) as well as compulsive indecisiveness (Frost & Shows, 1993). We expect that those individuals who buck-pass or procrastinate will have lower scores in ‘initiative’ and that maximisers will tend to have higher scores in ‘improvement’ than satisficers. In our conceptualisation Section 3, we discuss the similarities and differences between proactive cognitive skills and vigilance (Mann et al., 1997), the rational thinking style (Epstein, 1973, 1983, 1985, 1994, and 2003), and the situation specific thinking style (Novak & Hoffman, 2009). We are convinced that proactive cognitive skills will be useful to substantiate these rational thinking styles. It should be further analysed whether rational and vigilant individuals tend to have higher scores in proactive cognitive skills compared to non-rational and non-vigilant individuals.

According to Murphy and Davidshofer (1998) there is a huge need for psychological tests in practice and they defined three major fields of application for psychological testing, namely educational, personnel, and clinical testing. For the application of the PDM scale mainly the first two areas are of importance. The purpose of these tests is to classify and assign the subjects to different categories, which serve as source of information and therefore as basis for a specific decision for the observer. Furthermore, the results of the tests provide information on certain characteristics of the subject (Murphy & Davidshofer, 1998).

The PDM scale could be used in assessment centres to evaluate applicants regarding their cognitive skills and personality traits relevant in phases of problem structuring and decision-making, similar to scales like the Myers-Briggs Type Indicator to ascertain a person's basic preferences. Applicants with low scores in proactive cognitive skills and proactive personality traits (28.6 percent in main study II) could be regarded as less suitable for certain positions. The PDM scale could also be applied to personnel. Especially, at the stage of problem structuring, which is crucial for every OR application, it is highly important to have individuals with high proactive cognitive skills in a team since even the best method or algorithm will be ineffective as long as the problem is framed wrongly. In almost all OR applications it could be useful to have a team that consists of individuals with high proactive personality traits and individuals with high proactive cognitive skills who complement each other.

Furthermore, the PDM scale can be used to capture behavioural aspects in OR procedures. Companies often ask analysts for support in important and complex decision situations (*e.g.* building a new power plant, outsourcing of production, adopting new technologies, *etc.*). For offering tailor-made support, the decision analyst needs to understand the decision-making in a company with regard to the organisation itself and its stakeholders, *i.e.* managers and personnel. Completing the PDM scale a week before the kick-off meeting is a cost-effective option to measure the PDM of the individuals and the entire company. In contrast to individual conversations, this would save time and in contrast to group discussions, the use of the PDM questionnaire would prevent single opinion leaders from dominating the results, since certain individuals often lead decisions in companies (Crant, 1996).

9. Conclusion

This paper aims at developing a theoretically sound and empirically tested proactive decision-making (PDM) scale. Therefore, PDM is conceptualised, operationalised, measured, validated, and modelled with regard to explaining decision satisfaction.

We derive the concept from previous literature and identify six dimensions that describe necessary proactive cognitive skills (1–4) and proactive personality traits (5, 6) of individuals: (1) a systematic and active search for objectives (Objectives), (2) a purposeful and active search for information (Information), (3) a purposeful and systematic identification of alternatives (Alternatives), (4) a future-oriented and purposeful planning of decisions (Decision radar), (5) taking initiative (Initiative), and (6) the inherent desire to improve one's situation by striving for improvement (Improvement). By means of five studies, these six factors are identified of being of importance in PDM. On the basis of theoretical considerations and empirical results, PDM can therefore be defined briefly as follows:

> *Proactive decision-making summarises the purposeful use of cognitive skills and certain foresighted personality traits of the decision-maker.*

We argue that both, proactive cognitive skills and proactive personality traits, are relevant aspects of PDM. Furthermore, we assume that both aspects complement each other. The comparison of the decision satisfaction of participants with low and high scores in proactive cognitive skills and proactive personality traits respectively empirically verify this assumption. Since proactive personality traits are characterised to be relatively stable, individuals should enhance their cognitive skills in decision-making to achieve a higher decision satisfaction.

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Supplementary Materials

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