

BUSINESS DECISION MAKING: STUDYING THE COMPETENCE OF LEADERS

ABSTRACT

The problem studied relates to understanding the competence of leaders to take decisions and some of the psychological limitations involved in this process. The main objective of this study was to evaluate the decision-making competence of a sample of Brazilian people with positions of authority working on different sectors, providing a greater understanding of the role of leadership in business. We utilized components of the Adult Decision Making Competence (A-DMC) method. Results were based on a filtered sample of 49 leaders. The collected data allowed an analysis of the competence of individual decision-making, the group and a comparison with other literature studies. Moreover, evaluated executives outperformed senior leaders in the components of Resistance to Framing and Under / Overconfidence while they did not have such an expressive result for Consistency in Risk Perception and Resistance to Sunk Costs. It was also found that none of the executives achieved a flawless result in the questionnaire, thus evidentiating that all participants have room for improvement in decision making. Even though it is not the objective of this study to generalize these results to the Brazilian population, the outcomes are in line with those reported in the literature, and complement previous broader studies performed in the United States, Slovakia, Sweden and Italy by analyzing business leaders in the private sector, a target sample that had not yet been explored. It also provides insights for practical applications in the development of leadership competences.

Keywords: Business Leadership. Competence. Decision Making. Quality of Individuals' Decisions.

TOMADA DE DECISÃO EMPRESARIAL: ESTUDANDO A COMPETÊNCIA DOS LÍDERES

RESUMO

O problema estudado neste artigo diz respeito à compreensão da competência dos líderes para tomar decisões e algumas das limitações psicológicas envolvidas neste processo. O principal objetivo foi avaliar a competência decisória de uma amostra de brasileiros com cargos de autoridade atuantes em diferentes setores proporcionando uma maior compreensão do papel da liderança nos negócios. Utilizamos componentes do método *Adult Decision Making Competence (A-DMC)*. Os resultados foram baseados em uma amostra filtrada de 49 líderes. Os dados coletados permitiram uma análise da competência de tomada de decisão individual, do grupo e uma comparação com outros estudos da literatura. Além disso, os executivos avaliados superaram os líderes seniores nos componentes Resistência ao enquadramento e Excesso ou Falta de confiança, enquanto eles não tiveram resultado expressivo para Consistência para percepção do risco e Resistência a Custos passados. Verificou-se também que nenhum dos líderes obteve um resultado impecável no questionário, evidenciando, assim, que todos os participantes têm espaço para melhoria na tomada de decisão. Embora não seja objetivo deste estudo generalizar esses resultados para a população brasileira, os resultados estão em consonância com os relatados na literatura e complementam estudos anteriores mais amplos realizados nos Estados Unidos, Eslováquia, Suécia e Itália, por meio da análise de líderes empresariais no setor privado, uma amostra alvo que ainda não havia sido explorada. Ele também fornece intuições para aplicações práticas no desenvolvimento de competências de liderança.

Palavras-chave: Liderança Empresarial. Competência. Tomada de Decisão. Qualidade das Decisões.

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1 INTRODUCTION

As Smith, Wang and Leung (1997) point out being an effective leader requires the ability to handle a stream of challenges and threats to the organization's optimal performance. Many of the decisions business leaders face are intricate to an extent that can put the future of a company at stake. Our rationality limitations, which hinder and restrict our ability to make optimal decisions (Bavolar, 2013; Einhorn, 1970; Hunt, Krzystofiak, Meindl and Yousry, 1989) plus the innumerable variables, inaccurate information, difficulties to envision alternatives, constraints of time and costs can lead to highly undesirable results (Bazerman & Moore, 2012; Simon, 1955). Even under these scenarios, executives tend to be overconfident (Camarer & Lovallo, 1999) or present different behavioral responses depending on certain circumstances such as their physiological state, time pressure, cognitive load and social context (Appelt, Milch, Handgraaf & Weber, 2011; Mcelroy, Dickinson & Stroh, 2014; Köse & Şencan, 2016; Hrgović & Hromatko, 2017) which raises the question: how good are the leaders decisions in businesses environments?

Considering the importance of decision-making in the business environment and the associated rationality limitations outlined above, it is of vital importance to be able to measure the ability of leaders to take decisions. Without a structured way of assessing the individual competence of leaders in this theme, it is difficult to detect the necessary areas of improvement and drive individual improvement plans that will eventually result in better business results.

On the other hand, most of the literature aimed at studying individuals is focused on their decision-making styles and not on the actual competence. The research on styles focuses on identifying how individuals approach decisions, for instance, by investigating if they adopt a more rational or intuitive style or if they tend to seek for advice from others or postpone decisions. While these are interesting aspects of the decision-making framework, the competence itself is seldomly the central interest. We believe further research should be conducted to extend our knowledge on the competence in addition to the styles.

Moreover, the available studies focusing on the decision-making competence have targeted samples of the general population, undergraduate students, military personnel and leaders working in the non-private sector. In this article we chose to expand the research on competence by selecting business leaders in the private sector and posing the question: how good are leaders when taking decisions in businesses environments?

The main objective of this study was to evaluate the decision-making competence of leaders working on different business sectors and to investigate some of the psychological limitations involved in this process. In a broader way, this study may help establish the basis for other researchers who wish to evaluate the decision-making competence of executives bringing out an understanding of the individuals differences. This is an area of knowledge that has not yet been well investigated by other researchers (Armstrong, Cools & Sadler-Smith, 2012).

In terms of structure, this article is divided into four sections. The first of them addresses the decision-making framework considered in this research as well as the theoretical basis found in the literature to support this article. In the Materials and Methods section, we provide details on the instrument selected to assess the decision-making competence, individuals participating in the research, procedures used to apply the questionnaire and the methodological limitations. Once the theoretical basis and methods are explained, the third section brings the results obtained and sets forth a discussion on how these compare to the literature and address the central question posed by this article. Finally, in the Conclusion section, we summarize how this article contributes to the literature and provide recommendations for future studies on the same theme.

2 DECISION-MAKING FRAMEWORK

An important point in the decision-making research is to understand how the judgments and decisions are influenced by the individual differences. These are defined by Appelt *et al.* (2011, p. 253) as: "[...] a broad term, covering any variable that differs between people, ranging from decision styles to cognitive abilities and personality."

Most of the research on decision making of leaders focuses on the style and not on the competence. Some authors have conducted research on military leaders using instruments like Movement Pattern Analysis to assess their decision-making style and underlying motivational propensities (see Connors, Rende & Colton, 2013, 2014, 2015) or even by observing video images of heads of states (Connors, 2006).

Self-report measures, such as the General Decision-Making Style (GDMS from Scott and Bruce, 1995), have been extensively used, for instance, to assess correlations between decision-making style of Swedish military officers and mental abilities necessary on battlefield situations

(Thunholm, 2004) or to investigate differences in decision making style between army captains acting as leaders and followers (Thunholm, 2009).

Outside of the military world, Russ, McNeilly and Comer (1996) investigated links between decision making style, leadership style and performance of first level sales managers and Erenda, Meško and Bukovec (2014) investigated the presence of the GDMS intuitive decision making style in top and middle managers of the Slovenian automotive industry.

In the realm of International Relations, there are studies on the processes that drive political leaders to take decisions associated with public affairs (Mintz, 2004), on the profile and decision style of terrorist leaders (Chatagnier, Mintz & Samban, 2012) and on the fear of losing status and the escalation of commitment bias in political and military leaders (Renshon, 2015). However, these were not focused on the decision-making competence itself.

Armstrong *et al.* (2012) conducted a review of 40 years of research on the role of cognitive styles in business and management and found out a focus on decision-making style versus strategic decisions, presence of biases, risk perception, escalation of commitment and framing effects, but not on decision-making competence specifically. For this reason, we believe this article adds to the research in leadership and decision making on the business environment, an area not yet thoroughly explored.

In this relatively new field of measuring the decision making competence, our literature revision indicated the following available instruments:

- Problem Solving Inventory (PSI) (Heppner & Petersen, 1982);
- Youth-Decision Making Competence (Y-DMC) (Parker & Fischhoff, 2005);
- Adult-Decision Making Competence (A-DMC) and Decision Making Inventory (DOI) (Bruine de Bruin, Parker & Fischhoff, 2007; Parker, Bruine de Bruin, Fischhoff & Weller, 2017);
- Older Adult-Decision Making Competence (O-ADMC) (Finucane & Gullion, 2010);
- Pre-adolescent Decision Making Competence (Weller, Levin, Rose & Bossard, 2012).

The Problem Solving Inventory (PSI) (Heppner & Petersen, 1982) is one of the first attempts of measuring the problem-solving ability of individuals and is listed as a competence measure by the Society of Judgment and Decision Making (2007). It is a 32-item questionnaire that assesses an

individual's perception about the problem-solving abilities and reveals aspects such as: self-perceived confidence in solving problems, whether individuals tend to approach or avoid problems and elements of self-control. It relies on the assumption that better ratings on these constructs would be correlated to better problem-solving capabilities.

The test A-DMC (Adult Decision Making Competence) brings a correlation between individual competences and a 116-item questionnaire that assesses experiences with life events influenced by adults' decisions (DOI – Decision Outcomes Inventory) (both developed by Bruine de Bruin, Parker and Fischhoff, 2007). More specifically, higher A-DMC scores were correlated with higher DOI scores and, in general, most of the negative decision outcomes were associated with lower A-DMC, as well as younger and poorer people (Parker, Bruine de Bruin & Fischhoff, 2015).

The A-DMC was developed with adults (age range from 18 to 88) and encompasses the typical aging of leaders in the business. The other methods such as Pre-adolescent Decision Making, Y-DMC and O-ADMC are all established on the same basis of research, however with a target audience of pre-adolescents (10-11 years old), young people (18-19 years old) and senior people (65-97 years old), respectively.

The A-DMC and DOI are considered promising by Appelt *et al.* (2011), since they can predict the performance of people in real life decisions and there is evidence showing a relationship between cognitive functions of the brain and dimensions of competence in decision-making (del Missier, Mäntylä and Bruine de Bruin, 2012). The A-DMC research also found significant predictive validity when controlling for individual difference variables such as demographic characteristics, cognitive ability, and constructive decision-making styles (Bruine de Bruin *et al.*, 2007). Dewberry, Juanchich, and Narendran (2013) also utilized the DOI to investigate the relationship between personality aspects and decision-making competence since they considered the DOI as “the only measure of everyday decision-making competence currently available”, therefore reinforcing its importance.

In addition to the original application in the United States (Bruine de Bruin *et al.*, 2007), the same method or components have been also translated and applied in Slovakia (Bavolar, 2013), Italy (del Missier *et al.*, 2012) and Sweden (Marklund, 2008 as cited in del Missier *et al.*, 2012), which reflects a potential application in non-English native speaking countries. The A-DMC was also utilized by Carnevale, Inbar and Lerner (2011) on a

population of senior leaders visiting the Harvard Kennedy School of Government.

For the reasons explained above, the A-DMC method was selected for this study to evaluate the decision-making competence.

3 MATERIALS AND METHODS

The A-DMC components chosen were the same used by Carnevale *et al.* (2011) in previous studies with leaders (Resistance to Framing, Consistency in Risk Perception, Resistance to Sunk Costs and Under/overconfidence).

Resistance to Framing (RF) evaluates how decision making is affected by irrelevant variations in the problem description, since studies show that the same problem framed in different ways can influence its solution, although, normatively, the same decision should be made (Mc Elroy and Seta, 2003; Druckman, 2001; Tversky & Kahneman, 1981). In addition, most prescriptive decision making processes consider the formulation of the problem as the first step to get good results (Bazerman & Moore, 2012; Clemen & Reilly, 2001; Yu, 2011; Hammond, Keeney & Raiffa, 1999).

In the A-DMC, these items were divided as follows:

- Seven (07) items with options formally equivalent in terms of gains and losses, each one of them presenting a sure option and other with risks. One of the items utilized is the classical experiment from Tversky and Kahneman (1981) in which one has to take a decision on the best approach against the surge of a disease;

- Seven (07) items in which the participants have to evaluate either positively or negatively versions of equivalent events. Example: i) to apply a fine against a woman with 20% of chance that she did not know she was parking illegally or 80% of chance that she knew she was not doing the right thing. Another example ii) to evaluate the efficacy of a condom with a success rate of 95% or 5% or failure rate.

The positive and negative framings are separated by other tasks in the questionnaire in order to leave them as independent as possible. The performance on this component is measured by the absolute difference between the classifications of the gain and losses versions of the same item.

Example:

Problem 1 (“gains” version)

Imagine that recent evidence has shown that a pesticide is threatening the lives of 1,200 endangered animals. Two response options have been suggested:

If Option A is used, 600 animals will be saved for sure.

If Option B is used, there is a 75% chance that 800 animals will be saved, and a 25% chance that no animals will be saved.

Which option do you recommend to use?

	1	2	3	4	5	6	
	Definitely would choose A				Definitely would choose B		

Problem 5 (“losses” version)

Imagine that recent evidence has shown that a pesticide is threatening the lives of 1,200 endangered animals. Two response options have been suggested:

If Option A is used, 600 animals will be lost for sure.

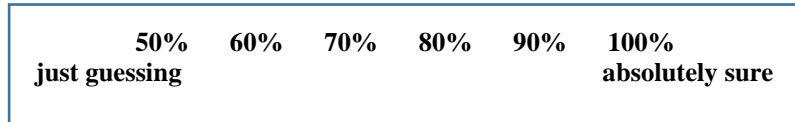
If Option B is used, there is a 75% chance that 400 animals will be lost, and a 25% chance that 1,200 animals will be lost.

Which option do you recommend to use?

	1	2	3	4	5	6	
	Definitely would choose A				Definitely would choose B		

The Under / OverConfidence (UOC) item measures how people recognize the extent of their own knowledge (metacognition) or, in other words, how confident they are and to what extent that trust corresponds to the reality of decision-making. In general, though, the majority of individuals tend to be overconfident (Griffin & Brenner, 2004) and the executives too (Camarer & Lovallo, 1999; Doukas & Petmezas, 2007).

The participants have to indicate whether an affirmative is false or true and then evaluate their



Consistency in Risk Perception (CRP) assesses the ability to follow probability rules including the susceptibility to the conjunction fallacy (Tversky & Kahneman, 1983). It requires the participant to flexibly switch between different event descriptions and time frames and judge the chance of an event to happen.

In the A-DMC, there are twenty (20) items in this component and the participants are required to judge the chance of an event happening to them on a linear scale from 0% (no chance) to 100% (certainty). These 20 items are divided as follows:

- Ten (10) items (05 pairs) are judged twice: they ask about the chances of an event happening in the next year and in the next five years. The intent is to verify if lower probabilities are associated with the events that occur in the next year rather than in the next 05 years. In other words, answers are considered correct if the probability of an event happening in the next year is not higher than in the next five years;
- Six (06) items (03 pairs) present characteristics of sets and subsets (example: the probability of dying from a terrorist

own self confidence in that answer. The performance is then measured as the difference between the correct responses (made available by the authors of the method) and the expressed confidence.

Example:

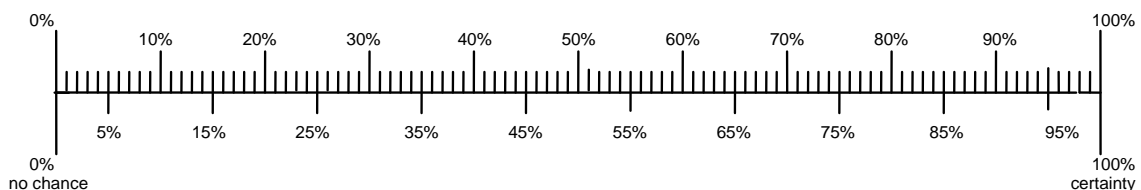
A venture capital fund invests in new businesses by providing startup capital.
This statement is [True / False].

- Four (04) items (02 pairs) present complementary events such as the probability of being involved in a car accident while you drive and the probability of not having an accident. The response is considered correct if the sum of the probabilities assigned to the events is 100%.

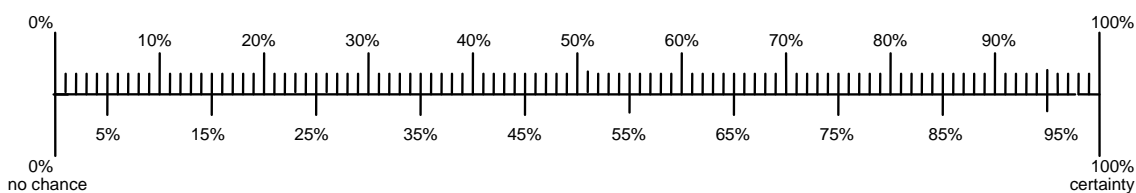
All pairs are separated in the questionnaire in order to keep them as independently as possible. The result of this component is then calculated as the percentage of consistent responses to the pair of questions.

Example of a pair of questions related to the next year and next five years:

What is the probability that you will visit a dentist, for any reason, during the next year?



What is the probability that you will visit a dentist, for any reason, during the next 5 years?



Resistance to Sunk Costs (RSC) refers to the propensity to continue an endeavor once an investment in money, effort, or time has been made. This can be one of the causes for an irrational escalation of commitment when taking decisions (Bazerman & Moore, 2012), since, normatively, unrecoverable past expenditures should be ignored and only future consequences be considered (Bazerman & Moore, 2012; Bruine de Bruin *et al.*, 2007; Hammond *et al.*, 1999; Kahneman, Lovallo & Sibony, 2011). However, there are evidences that the desire not to appear wasteful is a possible psychological justification for this behavior (Arkes & Blumer, 1985) and also that this behavior can affect both decisions of everyday life as more complex / strategic decisions (van Putten, Zeelenberg & van Dijk, 2010).

The A-DMC presents ten (10) items that measure this characteristic and are evaluated on a scale from 1 (option with sunk costs) to 6 (options normatively correct). The performance is measured by the average of responses in the 10 items.

Example:

Problem

You are in a hotel room for one night and you have paid \$6.95 to watch a movie on pay TV. Then you discover that there is a movie you would much rather like to see on one of the free cable TV channels. You only have time to watch one of the two movies.

Would you be more likely to watch the movie on pay TV or on the free cable channel?

1	2	3	4	5	6
Most likely to watch pay TV				Most likely to watch free cable	

The Table 1 summarizes the components, evaluation criteria, response scale and number of the items in the A-DMC method.

Table 1 – Summary of A-DMC components chosen in this article

Component	Description	Response scale	Number of items
Consistency in Risk Perception (CRP)	Assesses the ability to follow probability rules.	0 - 100% (performance is measured from the percentage of consistent responses to the pair of questions)	20
Resistance to Sunk Costs (RSC)	Evaluates the propensity to continue an endeavor once an investment in money, effort, or time has been made.	Scale from 1 to 6 (performance is measured by the average of responses in the 10 items)	10

		Scale from 0 to 5 (performance is measured by the absolute difference between the classifications of the gain and losses versions of the same item)	
Resistance to Framing (RF)	Evaluates how decision making is affected by irrelevant variations in the problem description.	(a) Verdadeiro / Falso (b) 50% - 100%	14
Under/overconfidence (UOC)	Measures how people recognize the extent of their own knowledge (metacognition)	(performance is measured as the difference between the correct responses and the expressed confidence)	34

Participants

In this article, we draw results from a sample of experienced team and business leaders instead of a typical undergraduate student sample, as it can be observed in other studies that use the same test. We would like to emphasize this point because we believe this provides a better replication of actual decision making in business settings for college sophomores may differ from adult samples in many senses (Sears, 1986). Some authors question the external validity of experiments with students when a replication of elite decision making is necessary, besides observing that authors have also noticed differences in susceptibility to decision biases between military leaders and Pittsburgh residents (Carnevale *et al.*, 2011), on decisions made by undergraduate political science students and military elite decision makers (Mintz, Redd & Vedlitz, 2006) and in political elite decision making where power, age and experience play a significant role in the decision making process and highlights that the use of students samples may not be appropriated (Renshon, 2015). With that said, we understand that a sample of undergraduate students would not have been appropriate for this particular study. The downside of this option is a restrict number of people who were in the desired profile, reducing the sample size available for analysis.

The questionnaire was addressed to 66 people, that fit the profile and we obtained 49 responses (74%). The sample was composed of 41 men and 7 women aged between 27 and 58 ($M = 35.80$ and $SD = 6.82$). No monetary incentive was offered to participants, only one feedback report with results and tips for improving their decision-making skills. The low relative number of addressed questionnaires is related to the difficulty in finding professionals within the desired profile who are willing to answer a questionnaire considered long by many of them.

Participants were recruited through a Master of Business Administration (MBA) course (41%) and others directly in the business market (59%). Leadership experience was a criteria for the admission process for all participants on the MBA course (mainly first level managers) and the other participants were asked to report on the number of years of leadership experience resulting in an average of 8.2 years ($SD = 6.8$ years). The confirmation of leadership experience of the sample was made as follows: a) all participants from the MBA course had to demonstrate leadership experience with team management during the admission process and were mainly first level managers b) other participants were asked to report on the number of years of leadership experience.

In terms of undergraduate course, 55% of the participants were engineers, 23% had a Business Administration, Accounting or Economics degree and 22% had varied degrees including Architecture, Nursing, Social Communication, Psychology and others. The vast majority of the participants (96%) worked in the private sector in several different companies in the industry and services businesses. Additionally, 94% of the participants were working in the southeast of Brazil at the time of data collection.

The sample size is compatible to ensure the objectives of this sociological research. First, we opted for a number of cases considered statistically sufficient to form a sample that allows the application of multivariate statistical analysis, given the high difficulty of obtaining a sample with the peculiar characteristics required in this study. Following the perspective from Kazmier (2009, p. 126-128), a sample with size n greater than or equal to 30 allows the use of the normal probability distribution associated with the standard error of the mean, following the Central Limit Theorem (CLT). It is expected in a future work, increase the sample size for other characteristics to be analyzed in terms

of social background, education, age, gender among other characteristics.

Procedure

Before the A-DMC was applied, it was translated from English to Portuguese by the authors with minor modifications. Some procedures to validate the questionnaire and its Portuguese version are in Appendix B. Application of the test was made either via a printed copy of the test (53%) or digitally (47%). Participants took around 45 to 80 minutes to complete it, which they considered very time consuming.

Everybody invited for the research had privacy, anonymity and total liberty to not participate at any time guaranteed. Participants were given a brief explanation about the research and provided consent in written or electronic form before filling the questionnaire.

Methodological Limitations

We would like to highlight two limitations of the present study. Firstly, the current study utilized an intentional sample of leaders, which may not be representative of the general Brazilian population in terms of age, education, social background and other aspects. Future studies should expand the application of the A-DMC to a heterogeneous sample in Brazil to verify its applicability to the broader population. A wider application can also consider the use of all six components as utilized in the original study (Bruine de Bruin *et al.*, 2007), although many participants voiced their dissatisfaction with the duration of the reduced questionnaire. The sample size precludes generalizations, however, is valid for the group of examined managers and for identification of problems in the Portuguese test. A second limitation is associated with the comparison of studies from different cultures and samples (in terms of size and composition). Here we have utilized other studies in the literature as a reference without trying to definitively infer on the causes of their differences.

We understand these cultural differences could be the object of further studies using the A-DMC in order to better understand its effects over the results.

4 RESULTS AND DISCUSSION

A score was calculated for each one of the 49 participants in each of the A-DMC components following the criteria established by Bruine de Bruin *et al.* (2007). The scoring key was available in Society for Judgment and Decision Making (2007). Appendix A brings the individual results.

The first result was that all participants presented some susceptibility to the known biases and judgment errors associated with decision making. While there has been three participants with a top score in RF (participants #7, #42 and #45), other three with maximum score in UOC (participants #28, #33, #37) and again participant #42 in RSC, nobody achieved complete immunity to the effects already reported in the literature. No single participant achieved top scores in all components. These results suggests susceptibility to the judgment errors typically reported in the literature, with different degrees of influence for each one of the participants.

Analysis of individual differences

A point to highlight in Appendix A is the variation in performance between participants and within components for a given participant. Taking as an example participant #7, who had the best result in RF (5.00), we verified that the same person had a less expressive result in UOC (0.86). Another example is participant #13, who had the worst result for CRP (0.50), but achieved a very good result in UOC (0.98). The relationship between A-DMC components allows these individuals to observe these areas of deficiencies, in which there is an individual field to improve decision making.

In order to provide a relative comparison between participants, we calculated the quartiles for each one of the components (see Table 2).

Table 2 - Quartile calculations for A-DMC components

Component	minimum	quartile 1	quartile 2	quartile 3	maximum
RF	3,00	3,86	4,43	4,64	5,00
UOC	0,79	0,91	0,93	0,97	1,00

Component	minimum	quartile 1	quartile 2	quartile 3	maximum
CRP	0,50	0,75	0,80	0,85	0,95
RSC	3,10	4,20	4,70	5,00	6,00

From the quartiles, we noticed that not a single participant had all grades into the 4th quartile, which would have indicated a distinctive performance in this dataset. Data showed, however, that participants #7, #10, #28, #37 and #46 had three components in the fourth quartile, therefore showing a better performance when compared to the group.

On the other hand, nobody had all grades in the 1st quartile, which would be an indicative of an overall poor performance. That said, participants #3, #9, #27, #39, #40, #44 and #48 had 03 components falling within the 1st quartile, therefore revealing a greater need for improvement.

We believe the use of quartiles provides a solid way of assessing each participant in comparison to the group. This reveals in which components they should focus their improvements efforts.

Correlations between components

Linear correlations were calculated between test components to analyze if the results

would be inter related (see Table 3). From the results, there was a positive moderate correlation (indexes within 0.3 and 0.7) between RSC and RF. On the other hand, the other components presented a positive weak correlation (index below 0.3) with the exception of CRP and UOC, for which the index was negative.

From these data, we concluded that, in general terms, there was a weak linear correlation between these variables what indicates that the performance for each component is not strongly tied between themselves. In other words, an increase (or decrease) in the performance for a given component implies small increases (or small decreases) in the performance of other components.

On the other hand, as the majority of correlation indexes are positive, an overall good performance in each component indicates a tendency of a better global performance, or better decision-making competence. This result was also verified by Bruine de Bruin *et al.* (2007).

Table 3 – Pearson correlation between test components

Component	RF	UOC	CRP
RF	---	---	---
UOC	0.06	---	---
CRP	0.27	-0.05	---
RSC	0.37	0.04	0.23

Correlations with age

Similarly to other authors, we investigated linear correlations between the age of the

participants and the performance on the A-DMC test (see Table 4).

Table 4 – Pearson correlation with age

Component	Pearson coefficient	Correlation
RF	-0.42	Moderate
UOC	-0.08	Weak
CRP	-0.10	Weak
RSC	0.08	Weak

From Table 3, there was only a moderate negative linear correlation between age and RF. The other components presented weak negative linear correlations, with the exception of RSC, which was positive. In this sample the performance in three of four components worsens with age.

Other authors have also not found indications of strong correlations with age. Bruine de Bruin *et al.* (2007) reported weak correlations for these components, but positive for RSC and UOC. Bavolar (2013) observed weak and positive correlations for all these components but the CRP, which had a moderate positive correlation (0.356). The results seem mixed in this aspect, but it is important to highlight that they are difficult to

compare given the differences in age and culture in the studies.

Comparative with other studies

Even though there are considerable differences between the current study and others in the literature with regards to the culture (country) and sample (size and composition), the results of this study were summarized in face of other researches. Due to these limitations, the data are presented for comparative terms, without trying to definitively infer on the possible causes of the differences of the results (see Table 5).

Table 5 – Comparison with other studies (sample characteristics)

Study	Country of application & origin of participants	Age	Main objective of research	A-DMC components
current	Brazil – Business leaders mainly from the private sector	27 - 58 ($M = 35.80$, $SD = 6.82$)	Evaluate the decision-making competence of leaders working on different business sectors	- RF - UOC - CRP - RSC
Bavolar (2013)	Slovakia - high school and university students	18 - 26 ($M = 20.71$; $SD = 2.38$)	Translation and validation of the A-DMC in Slovakia.	All except Path Independence
Carnevale <i>et al.</i> (2011)	United States – leaders visiting the Harvard Kennedy School of Government. Participants came mainly from US state,	n/a ($M = 46$; $SD = 7.73$)	Investigation of the relationship between A-DMC components and Need for Cognition. Investigation of decision making by	- RF - UOC - CRP - RSC

	local, and federal government or the US military		leaders in comparison to the original A-DMC sample.	
del Missier et al. (2012)	Italy - undergraduates	n/a ($M = 23.45$; $SD = 5.04$)	Investigation of the relationship between A-DMC components and executive functions of the brain	- CRP - Applying Decision Rules
Bruine de Bruin et al. (2007)	United States - people recruited through varied social service organizations and community groups in the greater Pittsburgh metropolitan area	18 - 88 ($M = 47.7$, $SD = 17.0$)	Construction and validation of the A-DMC in the USA	All

n/a: not available

The studies that dealt with the validation of the test in the United States (Bruine de Bruin *et al.*, 2007) and Slovakia (Bavolar, 2013) utilized the larger samples between the studies presented. From Table 4, is possible to note that the research with greater coverage in terms of age span was Bruine de Bruin *et al.* (2007) that involved people from 18 to 88 years old and was the original evaluation of the A-DMC. Bavolar (2013) utilized a sample of undergraduate students, which restricted the sample to younger people, even though the author demonstrated results comparable to the original study. Similarly, the study in Italy (del Messier *et al.*, 2012) was drawn from a sample of undergraduate students and focused on investigating relationships between two A-DMC components and functions of the brain.

This current study included people from 27 to 58 years old comprised of leaders working mainly

on the private sector, which is a distinction from previous studies. Even though Carnevale *et al.* (2011) also investigated the decision making competence of leaders, these were mainly working in government or military affairs.

Table 6 complements this comparative overview with the literature by bringing a compilation of the main descriptive statistical results.

A comparison of the mean results between the studies in Table 56 revealed that the performance of leaders in this study was better to what is reported in the literature for RF and UOC. On the other hand, the performance of the sample was less expressive for CRP and RSC. It is possible to notice, therefore, that, in mean terms, there is need for more development in these two specific components.

Table 6 – Comparison with other studies (descriptive statistics)

Component	Study	Observed range	Median (Mdn)	Mean (M)	Standard Deviation (SD)
	Current	3.00 - 5.00	4.43	4.25	0.53
RF	Bruine de Bruin et al. (2007)	1.00 - 4.92	3.83	3.72	0.61
	Carnevale et al. (2011)	n/a	n/a	4.03	0.59
	Bavolar (2013)	1.79 - 5.00	4.00	3.95	0.55
	Current	0.79 - 1.00	0.93	0.93	0.06
UOC	Bruine de Bruin et al. (2007)	0.50 - 1.00	0.93	0.91	0.08

	Carnevale et al. (2011)	n/a	n/a	0.92	0.07
	Bavolar (2013)	0.50 - 1.00	0.91	0.89	0.09
	Current	0.50 - 0.95	0.80	0.78	0.10
CRP	Bruine de Bruin et al. (2007)	0.20 - 1.00	0.70	0.70	0.16
	Carnevale et al. (2011)	n/a	n/a	0.84	0.10
	del Missier et al. (2012)	0.10 - 1.00	n/a	0.74	0.14
	Bavolar (2013)	0.25 - 1.00	0.80	0.79	0.16
	Current	3.10 - 6.00	4.70	4.62	0.63
RSC	Bruine de Bruin et al. (2007)	1.00 - 6.00	4.50	4.40	0.77
	Carnevale et al. (2011)	n/a	n/a	4.94	0.87
	Bavolar (2013)	1.00 - 6.00	4.30	4.25	0.84

n/a: not available

5 CONCLUSIONS

We believe this study brings several contributions to the decision making in the business environment. Firstly, we identified that the literature typically focused on the decision making style of leaders whereas we are bringing a different perspective by studying the competence. We see this as a key factor considering the importance of actual results in the business world. The application of the questionnaire revealed susceptibility to the judgment errors typically reported in the literature, with different degrees of influence for each one of the participants. Considering that one of the most important tasks of a business leader is to take decisions, having a systematic way of measuring this competence is relevant for the assessment of leaders. Also, increasing awareness about judgment biases, providing a feedback about people's performance and training executives to be capable of identifying these limitations can minimize decision making errors (Hammond *et al.*, 1999; Keeney, 2004; Kahneman *et al.*, 2011; Bazerman and Moore, 2012). Ultimately, one could infer that a higher competence on decision making would be associated with more effective leadership as a whole.

The current sample is comprised of business leaders from the private business and from different sectors, which adds diversity to other studies of styles and competence. Other studies focused on undergraduates (Bavolar, 2013; del Missier *et al.*, 2012), a heterogeneous population sample (Bruine de Bruin *et al.*, 2007), military

leaders (Carnevale *et al.*, 2011; Connors *et al.*, 2013, 2014, 2015; Thunholm, 2004, 2009), political leaders (Connors, 2006; Mintz, 2004; Renshon, 2015), terrorist leaders (Chatagnier *et al.*, 2012), sales managers (Russ *et al.*, 1996) and managers from the automotive industry (Erenda *et al.*, 2014). Also, by not using college sophomores, we do not need to rely on a possible relationship between the performance of an unexperienced sample and leaders, thus avoiding possible differences already reported in the literature (Mintz *et al.*, 2006; Renshon, 2015; Sears, 1986). As noted by Carnevale *et al.* (2011) and Sears (1986) using leaders as research participants may also affect how seriously these results are taken outside of the psychologist's world. As noted by these authors, studying leaders may strengthen their belief that the typical findings of decision-making research do apply to them, which would then make them more open to debiasing prescriptions and advice.

We believe there are practical implications from this research as the A-DMC could be applied in other business scenarios, such as recruitment processes and performance assessments. In this research, the application of the A-DMC allowed the assessment of the leaders with regards to an absolute criterion (A-DMC scale) or to a relative criterion (comparison with the group), which can be of interest to practitioners. These results provide insights for the individual development of business executives. This research expands the use of the A-DMC outside of the English-speaking world, by being, to the extent of our knowledge, the first

attempt of a translation to the Portuguese language. This adds to the already published studies from Slovakia (Bavolar, 2013), Italy (del Missier *et al.*, 2012) and Sweden (Marklund, 2008 as cited in del Missier *et al.*, 2010). The results observed fall within results from the other published studies with a closer proximity to those obtained by Carnevale *et al.* (2011) than to the original application of the questionnaire (Bruine de Bruin *et al.*, 2007).

We believe that the choice of the samples (leaders) and the relationship between performance scores and education could be an influencing factor for the results to be closer to Carnevale *et al.* (2011). The age structure of the sample, while possibly a factor, has been seen as of lesser relevance since no significant correlation between A-DMC and age emerged in the original application (Bruine de Bruin *et al.*, 2007). It is also possible that cultural aspects would be a contributing factor to some of these differences. The descriptive statistics observed are in line with those reported in the literature, thus providing indication that the A-DMC can be used to help business leaders identify key areas of improvement in decision-making competence.

Future research directions

The applicability of this method in the business environment is worth discussing. The A-DMC questionnaire has been developed and demonstrated to be correlated to real life decision making as measured by the Decision Outcomes Inventory (DOI), which is a self-report based on general aspects of life (e.g. being in a jail cell overnight for any reason; being in a public fight or screaming argument; declared bankruptcy). In some aspects, these scenarios do not directly relate to the business world, which could pose a question to its applicability to the businesspeople. We believe this is not the case, since the studies conducted by Bruine de Bruin *et al.* (2007) and further expanded by Carnevale *et al.* (2011) involved a very broad sample of American people in terms of social background, education, age, gender among other characteristics and the A-DMC skill set was demonstrated to be a unified construct central to decision making. That said, we consider there is room for future research that explores the relationship between A-DMC performance, DOI and actual decision making tasks in business scenarios.

Finally, we would like to point out other areas for the advancement of knowledge. We believe correlations between decision-making and age (like fine wine), the number of people led by the leader (i.e. a proxy for complexity) and salaries could be investigated. A comparison of the ability to make decisions between leaders and non-leaders would

also be worthwhile to better understand the role of experience.

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APPENDIX A

Individual results of the A-DMC test application ($N=49$)

Table A.1 – Individual results

Participant	Component			
	RF	UOC	CRP	RSC
	obs: the closer to 5 the better.	obs: the closer to 1 the better.	obs: the closer to 1 the better.	obs: the closer to 6 the better.
#1	3,21	0,84	0,85	4,90
#2	4,50	0,97	0,65	5,00
#3	3,57	0,81	0,75	4,70
#4	4,79	0,92	0,65	3,30
#5	4,71	0,92	0,90	4,10
#6	3,50	0,91	0,75	4,70
#7	5,00	0,86	0,95	5,30
#8	3,79	0,96	0,75	4,50
#9	4,00	0,91	0,65	3,70
#10	4,93	0,95	0,95	5,50
#11	4,57	0,98	0,75	5,60
#12	4,21	0,96	0,75	4,80
#13	4,57	0,98	0,50	4,80
#14	4,43	0,84	0,60	5,20
#15	4,79	0,93	0,85	4,90
#16	4,43	0,97	0,80	4,30
#17	4,21	0,99	0,75	5,00
#18	4,50	0,93	0,70	4,20
#19	4,36	0,99	0,75	4,90
#20	3,93	0,97	0,75	5,70
#21	4,29	0,99	0,80	4,60
#22	4,64	0,95	0,90	5,00
#23	3,86	0,96	0,90	5,50
#24	3,07	0,91	0,80	4,20
#25	4,64	0,97	0,95	5,00
#26	4,50	0,93	0,65	4,80
#27	3,50	0,93	0,75	4,20
#28	4,71	1,00	0,80	5,10
#29	4,14	0,96	0,75	4,60
#30	4,43	0,79	0,85	4,80
#31	3,86	0,90	0,80	4,70
#32	4,36	0,98	0,85	4,70
#33	4,57	1,00	0,85	5,20

#34	4,79	0,80	0,85	4,20
#35	3,79	0,93	0,80	4,10
36	4,79	0,95	0,75	4,00
#37	4,71	1,00	0,90	3,90
#38	4,21	0,99	0,85	3,60
#39	3,57	0,92	0,75	4,00
#40	3,00	0,98	0,55	3,10
#41	4,43	0,90	0,90	4,50
#42	5,00	0,92	0,80	6,00
#43	4,00	0,94	0,85	4,20
#44	3,57	0,91	0,70	3,50
#45	5,00	0,86	0,65	5,50
#46	4,50	0,98	0,90	5,10
#47	4,57	0,86	0,85	4,60
#48	3,36	0,90	0,70	4,30
#49	4,57	0,84	0,90	4,20

APPENDIX B

The Portuguese version of the A-DMC

During the process of validation of Portuguese version of test, points for improvement were identified and are described here:

1. One of the participants reported difficulty to comprehend problem 22 (CAL section) since it mentions payments in parcels and later the payment of a complete amount at once:

“Credit card companies can offer lower payments if you can come up with a lump sum settlement.” (original english version)

“Empresas de cartão de crédito podem oferecer parcelas menores se você puder pagar um montante de uma só vez” (initial portuguese version)

The original text references the expression “lump-sum settlement”, which indicates a condition in which a debt is negotiated and substituted for an equivalent single payment (or sometimes a small amount of parcels), whose value is usually smaller than the total sum of the debt. Based on the feedback received, we noticed the wording could be improved to clearly inform the meaning of lump-sum settlement, as follows:

“Empresas de cartão de crédito podem oferecer melhores condições para quitação de dívidas se você puder pagar um montante de uma só vez”. (final portuguese version)

“Credit card companies can offer better payment conditions to pay off a debt if you can come up with a single payment” (direct translation of the final Portuguese version)

2. One of the participants reported difficulty to understand Problem 5 (section A2) where it says:

“The label says 20% fat ground beef” (original English version)

“O rótulo diz: 20% de carne moída com gordura” (Portuguese version)

The participant did not understand what would be the composition of the other 80% of the ground beef, thus reporting difficulty to choose an alternative. This can possibly rely on the fact that in Brazil the percentage of fat is not reported in ground

beef labels, thus leaving room for doubt. However, considering that this Problem is an alternative framing to Problem 9, which reads “The label says 80% lean ground beef”, it was considered that any additional clarifications could possibly suggest an association between the two problems and induce responses that would alter the original intent of verifying resistance to framing. As no other participant reported difficulties in this point, the wording was not altered.

3. One participant reported in Problem 1 (Section SC) the possibility to interpret that there could be different delivery dates between the offers for the rings from the two stores, what would make it difficult to choose one option (buy in the old store or in the new one), since no clear criteria was given in this sense. This Problem is part of the section called Sunk Costs (SC) and its objective is the comparison between a purchase of a ring made at a higher cost and the possibility to change it for a new purchase (at another store) at a smaller price with all the other conditions being the same (including delivery dates). Normatively, the correct decision is the one of lesser costs, so, in other words, the old purchase should be cancelled and a new purchase be made at the new store, with only different pricing points being involved. To avoid possible misinterpretations and considering that the alteration would not induce any particular response, the following phrase was added by the end of the original wording:

“Além disso, com exceção do preço, todas as outras condições da compra (prazo de entrega, garantia, etc) são as mesmas.” (Portuguese version)

“In addition to that, with exception of price, all the other purchase conditions (delivery date, warranty and so on) remain the same.” (direct translation of the Portuguese version)

4. One participant questioned if the word “worse” (“pior”) in Problem 14 (section CAL) should not be interpreted as higher (“maior”) or more serious (“mais grave”):

“Procrastination is worse when you work in a cluttered environment.” (original English version)

“A procrastinação é pior quando se trabalha em um ambiente desordenado”. (Portuguese version)

By analyzing the original English version (“worse”), both translations suggested by the participant would be possible with subtle differences to its meaning. It was decided that the word “maior” (“higher”) would fit better considering that a cluttered environment may increase the occurrence of procrastination.

5. The Problem 5 (section RC1) presents a scenario on the chances of surviving a cancer treatment as well of being alive in the next 5 years:

“Surgery: Of 100 people having surgery, 90 live through the operation, and 34 are alive at the end of five years.” (original English version)

“Cirurgia: de cada 100 pessoas submetidas à cirurgia, 90 sobrevivem à operação e 34 permanecem vivas por um período de 5 anos.” (Portuguese version)

One of the participants reported doubt on the problem comprehension, since, according to him, the wording would not be clear as to what happens

with the rest of the people not mentioned in the text (in this case, 66 people that would not be alive by the end of five years). This doubt hinges on the translation of the wording “are alive”, which initially was translated to “remain alive” (“permanecem vivas”). In light of this comment, we opted for a literal translation in order to minimize the possibility of doubts as follows (also applied to the radiotherapy alternative):

“Cirurgia: de cada 100 pessoas submetidas à cirurgia, 90 sobrevivem à operação e 34 estão vivas ao fim de 5 anos” (Portuguese version)

6. The full version of the questionnaire in Portuguese (37 pages) can be found at the link: <https://blogdagestaoempresarial.wordpress.com/2018/06/11/10/>
7. If you are interested in taking the test, you can do it here: https://docs.google.com/forms/d/1QQjt06dOqRiF0mM9lgnn9lgEVAN_y4bB9TR1brvHBN0/viewform?c=0&w=1