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DEVELOPMENT AND VALIDATION OF A NOISE IN DECISION INVENTORY FOR ORGANIZATIONAL SETTINGS

Sara Bollarino	Department of Human Sciences, University of Verona, Verona, Italy	sara.bollarino@gmail.com
Andrea Ceschi	Department of Human Sciences, University of Verona, Verona, Italy	andrea.ceschi@univr.it
Michele Monti	Department of Human Sciences, University of Verona, Verona, Italy	michele.monti@univr.it
Riccardo Sartori*	Department of Human Sciences, University of Verona, Verona, Italy	riccardo.sartori@univr.it

* Corresponding author

ABSTRACT

Aim/Purpose	The aim of the present paper is to present a Noise Decision (ND) scale. First, it reports the development and validation of the instrument aimed at examining organizational factors that have an influence on decision-making and the level of noise. Second, it validates this rating scale by testing its discriminant and convergent validity with other measures to assess decision-making qualities.
Background	According to the literature, the concept of noise is the unwanted variability present in judgments. The notion of noise concerns the systematic influence to which individuals are exposed in their environment. The literature in the field has found that noise reduction improves the perception of work performance.
Methodology	The first study involves the development of a scale (composed of 36 items) consisting of semi-structured interviews, item development, and principal component analysis. The second study involves validation and convergent validity of this scale. In the first study, there were 43 employees from three medium-sized Italian multinationals. For the second study, a sample of 867 subjects was analysed.
Contribution	This paper introduces the first scale aimed at assessing noise within individuals and, in the organizational context, within employees and employers.

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Findings	Results show that the estimated internal reliability for each of the ND subscales and also the correlations between the subscales were relatively low, suggesting that ND correctly measures the analyzed components. Furthermore, the validation of the psychometric qualities of the ND allowed for the assertion that the influence of noise is present in the decision-making process within the context of work environments, validating the initial hypotheses.
Recommendations for Practitioners	This study represents a further starting point for the expansion of the literature on decision-making and consequently represents an additional source for structuring training interventions within organizations.
Recommendations for Researchers	This paper aims to improve theory and research on decision-making; for example, by providing a possible implementation for scales for evaluating decision-making skills. Furthermore, detecting and limiting noise with a systematic method could improve both the quality of decisions and the quality of thought processes.
Impact on Society	This scale offers the means by which researchers and practitioners can detect the effect of noise and promote training or interventions meant to reduce cognitive biases.
Future Research	Given the measurement of ND, the study can be a starting point for future research on this topic. Since there is no literature about this construct, it would be necessary to spend more time researching, so that the topic becomes clearer. System noise has been tested by some researchers with a “noise audit,” which means giving the same problem to different people and measuring the differences in their responses. Repeating this kind of audit in conjunction with the ND in a specific work environment could be helpful to detect but also measure the influence of noise.
Keywords	noise, decision-making, validation, heuristics & biases

INTRODUCTION

THEORETICAL FRAMEWORK

In decision-making and judgment in recent years, there has been growing recognition of the impact of a new theoretical concept called noise in various contexts, including the organizational setting. Noise, as described by Kahneman, Sibony, and Sunstein (2021) in their book *Noise: A Flaw in Human Judgement*, refers to random variability in judgments that can lead to errors and inconsistencies. This article aims to present the construction and validation of a new tool for detecting and addressing noise in the organizational context.

As noise is such a new concept in psychology literature, it is crucial to introduce a theoretical framework for decision-making and factors influencing the process, starting from the first contributions. Simon's (1955) theory of limited rationality suggests that humans are not always able to make fully rational decisions due to limitations in cognitive capacity and processing power. This means that individuals often rely on mental shortcuts to simplify decision-making processes and save time and effort. These kinds of fast judgment processes are called heuristics. Although at times useful, always relying on heuristics might lead to systematic errors as well, known as biases. Biases are systematic errors as individuals are consistently led to make the same judgment errors in certain situations (Kahneman, Sibony & Sunstein, 2021).

While systematic biases have been well-studied in the literature, there has been less attention given to the impact of noise. However, in the last few years, scholarly authors in the field of Judgment and

Decision-Making (JDM) are heightening their attention on the topic. Researchers have extensively discussed the decision-making process and the notions of Systems 1 and 2 (Stanovich, 1999) have become in common use. The two systems of thought are activated when individuals make decisions or make judgments. System 1 operates quickly and automatically without any control, whereas System 2 directs attention to demanding mental activities that require focus. The former constantly produces cues for the latter (intuitions, sensations, impressions) which, when corroborated by System 2, are transformed into beliefs and consequently into voluntary actions. When System 1 encounters some difficulty, it turns to System 2 for detailed and specific elaboration to solve the contingent problem. Systems 1 and 2 are influenced by heuristics and cognitive bases. Heuristics are mental shortcuts that lead to quick conclusions, which do not require cognitive effort. Within the macro-category of heuristics, we find cognitive biases and systemic errors that people make in judgments on facts and events; cognitive biases represent how our decision-making distorts reality (Kahneman, 2011). However, cognitive biases and heuristics are not enough to explain all the errors that occur in decision-making. In this regard, Kahneman describes the concept of noise as the unwanted variability that can occur in our judgments. This variability can be caused by a variety of factors, including personal biases, environmental factors, and other sources of randomness. The notion of noise regards the systematic influence to which individuals are exposed in their environment. Although Kahneman is not the first to introduce the concept of noise, he is one of the first to extensively study and document the impact of noise on human judgment. His work highlights the fact that even highly trained professionals, such as judges, doctors, and financial analysts, can be influenced by noise, leading to inconsistent and sometimes incorrect decisions. In this paper, we focus on system noise, which is particularly important in the organizational environment affecting how individuals in the workplace may make flawed choices or have questionable behaviors.

Various studies have been done to demonstrate the presence of system noise in the workplace; two examples will be reported here. To begin with, in a study involving 22 doctors, the same clinical report was reviewed several months later. The study revealed how doctors disagreed with themselves between the first and second evaluations. Nothing had changed at the situational level, except the specific time when they filled out the report (Goldsmith et al., 2012). Another example of noise is given by a study conducted on American judges. It was shown how the judgment of an American judge in giving a sentence could change depending on the victory or defeat of his American football team (Eren & Mocan, 2018).

In the organizational context, the presence of noise in employees' and employers' decision-making can have numerous implications at the individual, organizational, and social levels. The influence of this type of error in judgment, essentially, is clear when different people do not have the same answer for something that is supposed to get a unanimous answer. We could provide an example of this issue by referring to the current pandemic situation and the various anti-Covid measures that need to be brought into the organization. Managers have to make many decisions, in a rather short time, about new elements of occupational safety: regularity of covid tests for the employees, distance keeping, providing surgical masks and hand sanitizers, room sanitization and ventilation, and so on depending on the specific work characteristics, such as disposable gloves or towels for shared utensils. Applying these other preventive measures, that are recommended but not mandatory, should be at the entrepreneur's discretion. This type of decision could have positive consequences on an individual level, as the perceived safety in the work environment increases, on an organizational level, such as a higher possibility of traceability, and even on a social level, since the organization would appear as a good model for other companies, for buyers and clients as well.

Nonetheless, the urgency, newness, and delicacy of the whole pandemic circumstance can promote noise in how managers act. They find themselves in front of an issue that needs a quick solution and may end up not implementing the recommended measures, therefore bringing negative consequences in all of the three already cited contexts. At the individual level, by not applying a sufficient amount of measures, more employees can get ill, and consequently, at the organizational level, the income

would drop due to the lack of employees. At the contextual level could be, in the first place, the diffusion of the virus, but also the issue of having a growing number of families forced into isolation. In this vein, detecting and restricting noise into a unique assessment tool can represent a useful instrument for organizations and improve employees' and employers' decision-making processes. However, there are no assessment tools that can help in the measurement of noise. This is surprising considering that measuring and internalizing the existence of noise may be fundamental because it improves the quality of decisions and it will limit errors that, if not avoided, may accumulate (Kahneman, Sibony, & Sunstein, 2021). For this reason, developing measures would provide experts with useful tools to predict and anticipate noise so that they can intervene in the workplace by recognizing the elements that create noise and helping organizations in its reduction. Accordingly, there will be evident and tangible consequences in the organizations themselves, which will be able to make decisions that will no longer be influenced by the context, and therefore by noise. Furthermore, the reduction of noise will improve job performance and well-being.

Given the absence of an assessment tool for noise, the purpose of this study is to propose a Noise Decision (ND) inventory. This scale is meant to give researchers and practitioners the possibility of detecting the presence of noise within individuals and in the organizational context, within employees and employers. The concept of noise highlights the importance of understanding and addressing the impact of random variability on judgment and decision-making, especially in the organizational context: by developing an inventory to detect and address noise, organizations can improve the accuracy and consistency of their decision-making processes.

Therefore, this study has two aims. The first aim is to propose a novel instrument of ND which we will pursue with Study I. Here we develop a tool, available for different job positions, that could examine many organizational factors that have an influence on decision-making. Thus, we opted for a qualitative-quantitative approach based on surveying and semi-structured interview questionnaires, with different organizational decision-makers profiles and first, a quasi-systematics analysis. The second aim is to provide robustness to the inventory via a second study. Here we show how the psychometric qualities of ND are validated by testing its discriminant and convergent validity with other measures for assessing decision-making constructs. The Discussion section is divided into five subsections. In the first, the objectives (purposes) of the study, the methodology, and the results are reported. In the next two subsections we discuss the theoretical contributions made by this research. The fourth subsection treats the limitations that emerged. Finally, the last subsection outlines the research and practical implications of ND.

STUDY I

PRESENTATION

The purpose of Study I was to generate the items and determine the construct validity and psychometric properties of ND. Like most of the latest research, the original configuration of the complex JDM focused on the managerial judgment processes, and it was limited to a small number of environmental variables. A multi-dimensional structure on the role of environment on decision-making management (DEM), that recall the Noise concept, was already considered by Bandura and Jourden (1991) as able to hinder or boost decision-making self-efficacy through the behavioral mechanisms of feedback. On the other hand, considering the primary importance of managerial decisions, only a little attention was directed to the interpersonal factors affecting the decision-making of the subordinates. Contemporary times see employees of all levels being more involved in the process of organizational decision-making, due to the current nature of the work environment. While years before manager's involvement in decision-making was the only one needed, nowadays it also serves to create a sense of belonging among the workers, as well as a congenial environment in which both the management and the workers voluntarily contribute to enhancing the organization's performance (Noah, 2008). Today, all organization members must be involved in decisions for the organization, at some

level, to understand the need for creativity and, starting from the fundamentals, to be committed to changing their behavior at work in new and improved ways (Kingir & Mesci, 2010; Singh, 2009).

The topic of decision-making processes in the organizational context has not had great attention in the field, much less a deepened analysis of the environmental work factors that can be described as part of system noise, therefore making a quasi-systematic review to synthesize the current progress was not possible. Considering the management role, existing measures of JDM in the literature do not include all the unwanted variability defined as noise by Kahneman, Sibony, and Sunstein (2021): the supervisor's role in the decision-making process, the climate between colleagues, and the emotional impact on these processes. Therefore, the conceptual structure here considered includes the supervising role and the affective relations with organization members as interpersonal behavioral determinants of choice in the workplace. In the present study, our intention is to develop a more inclusive instrument, available for different job positions, which could examine the many organizational factors that can influence the decision-making process. Accordingly, we first conducted a qualitative-quantitative approach, based on questionnaire surveying, but also semi-structured interviews with different organizational decision-maker profiles. Hereinafter, we briefly describe the phases of the first study that led to the development of ND.

This study presupposes a set of methodologies aimed firstly at creating the ND inventory and secondly at validating it. In the first study, interviews were conducted with employees of three organizations to create the questionnaire, and the statements obtained from these interviews were divided into three groups according to Bandura and Jourden's (1991) model. Subsequently, a Q-sort test was used to assess the validity of the questionnaire. An intelligibility and clarity analysis was carried out to assess the comprehension of the items, using a pilot questionnaire. Finally, a multiple correspondence analysis was used to arrive at the final number of items making up the scale under consideration.

SEMI-STRUCTURED INTERVIEWS WITH ORGANIZATIONAL DECISION-MAKERS

Forty-three employees, from three medium Italian multinational companies, were recruited as a sample for a series of interviews. The participants' selection was conducted using an HR template to systematically obtain information regarding each employee's history, role, and job position revealing a variegated sample (age, $M = 33$ years, $SD = 10.11$; female population = 45%; job position: clerks 57%, general workers 26%, middle managers 10%, company managers 7%). All respondents who agreed to participate took part in a twenty-minute structured interview. The interviews (digitally recorded, professionally transcribed verbatim, and checked for accuracy) were aimed to establish (a) the relevance and frequency of strategic decisions made at work, (b) the presence of common work environmental variables, (c) their effects on decision-making and in turn on performance and well-being. The semi-structured form of the interview included questions on how the work environment, in all its domains, could positively or negatively influence the quality of their decisions made at work, and how this could have a recursive effect on their performance and well-being.

Preliminary results revealed, at first, how strategic decision-making was not just ascribed to the management, but instead, equally distributed inside the organization among different roles. Almost all respondents reported how their role was associated with the perception of high decision latitude and choice responsibility (e.g., see the following interview extracts: "I believe we make a lot of decisions here [R&D department], decisions that managers would hardly understand. Still, they conceive of our job as 'mechanic', whereas I believe that we use a lot of creativity here, and our decisions will have a huge impact on the future of this company." "I do feel the responsibility. Tough decisions come often, and they are stressful if your supervisor is not supporting you. Our work [HR department] is emotionally intense, even if I feel quite detached sometimes because everything here is about human relationships"). In the private service sector, employees are encouraged to develop their professional network.

After coding, several patterns emerged from the qualitative analysis of observed co-occurrence interview elements and are reported here. The first element common in all the interviews is that strategic decisions happen at several levels, and it is not only a matter of top management. Concerning work and organizational elements which interfere with the decisions made, they mostly referred to interpersonal behavioral dynamics, characterized by the presence of a lack of social support, with great emphasis on the role assumed by the supervisor role. Nevertheless, the climate between colleagues and the emotional impact of it appears to have a great influence on decision-making processes.

In line with Kahneman, Sibony, and Sunstein (2021) contribution to defining noise, emotional aspects deriving from workplace relationships are perceived as the first dimension of influence in decisions made at work. Colleagues' support, supervisor presence, and collaborative climate are confirmed to be differently able to affect or support decision-making, resulting in two relevant implications for both the personnel and the company. First, employees interpret the fact of being involved in the decision-making processes as a cue of appreciation by their supervisors and valued members of their organization by boosting their engagement at work. At the organizational level, it facilitates the flow and the exchange of important information within an organization, enhancing their understanding of organizational goals and performance (Int.12), e.g., "Only when people communicate you get all the information that you need for making good decisions and you feel part of something of bigger. Of course, this is of interest for the company too! [Int.3]". "How can you expect to make good decisions if your colleagues do not take part in such a process? All the responsibility is on me! And they do not actually care! [Int.6]"; "Decisions come from me, and me only. I'm not very influenced by other colleagues' opinions, I found them even annoying, and actually, my supervisor is not the person that I trust in decision-making. [Int.24]"; "My supervisor is the only person who I consult when I have to make a relevant decision [Int.19]".

Concerning the cognitive aspects and the properties of the organizational environment (e.g., Int.1, Int.32, Int.16), they have been mostly perceived as time-demanding and energy-consuming, which can have only a negative impact on decision-making efficiency. In line with Bandura and Jourden's (1991) studies, these determinants, before having a repercussion on performance, have a psychological impact on the decision-maker as persona, both in terms of energy consumption and on self-evaluation processes hindering. Moreover, we also noticed that a subjective sensitivity toward these environmental variables exists, since participants differently stated how these factors would influence their decisions, e.g., "Decisions are so relevant in my job [Accounting]. We process a lot of information since we have a reduced short memory which we try to keep only some issues and we try to reset all the rest. I'm pretty good at this, but I cannot say the same about my colleagues. I could also say that I kindly even like all these stimuli, make my job more interesting [Int.4]"; "The problem with decisions is that even when you care, the organization doesn't help you at all. You need time to think, and with all the duty and the annoyances, you cannot really focus. I don't have any idea about how others can deal with this, I just cannot. [Int.9]".

In light of these aspects, we could state that most of the analyzed elements reflect both the DEM structure and the noise concepts.

ND ITEMS GENERATION AND Q-SORT, INTELLIGIBILITY AND CLARITY TESTING

Before starting, ethical approval was obtained from the University of Verona, Research Ethics Committee. The next procedures were approved in accordance with national legislation and university guidelines. All the subjects involved participated in the study on a voluntary basis and gave their informed consent. The respondents consisted of employees operating in different Italian companies. A total of 1,000 questionnaires were printed and sent to these companies. Of those questionnaires, 682 employees filled out and returned them (response rate 68%). The sample includes 316 females (47%). Their age range is between 20 and 62 years with an average of 40 years. The majority of the sample has higher vocational training (24%) or a high school degree (43%). Most participants work as clerks

(61%), and 6% are company managers. Socio-demographic questions assessed are age, gender, education level, length of service, job contract, job position, number of staff supervised, and job sector. All the scales offered several options based on a simplified Italian job and contract classification.

In order to develop ND items, we considered frequency and effects registered from every work characteristic that emerged from the interviews, by taking into account the different decision-maker profiles present in the organization. We reached the overall number of 48 declarative statements, organized in the revised triadic Bandura and Jourden (1991) model, and supported by noise literature, as follows: (a) interpersonal behavioral determinants (24 items concerning colleagues support, supervisor presence, collaborative climate), (b) properties of the organizational environment (16 items concerning job and organizational demands, bureaucracy hassles), (c) cognitive and analytical aspects (8 items). To increase accuracy, we performed a Q-sort test on almost half of the sample of decision-makers previously interviewed ($N = 20$), moreover, we analyzed the levels of intelligibility and clarity of the set of items through a pilot questionnaire. Each participant was given an envelope containing 48 cards – the Q-set – and three paper clips. They were asked to group the items in accordance with a principle of logic and similarity by not providing the names of the corresponding categories. Based on the Q-set data formed by participants, we created a contingency matrix through the row and column profiles by using dichotomous variables in which rows correspond to the relative frequencies of the items for all the categories created thanks to the Q-Sort method.

After the Q-sort test, a Multiple Correspondence Analysis (MCA) was performed. MCA is for examining tables containing three or more variables. MCA can be considered a generalization of PCA for categorical variables that reveal patterns in complex data sets without requiring an assumption of underlying normality (Ayele et al., 2014). MCA was performed on a contingency matrix, the pattern showed that, with 87% of cumulative inertia, three categories could explain much of the variance (Ayele et al., 2014). Therefore, we deemed that three components were fully sufficient to define the three dimensions (i.e., cognitive aspects, interpersonal behavioral mechanisms, and the properties of the organizational environment). In the end, the questionnaire had the same set of items to investigate the degree of intelligibility and clarity of every single item on a scale ranging from 0 (not at all) to 4 (very clear). We checked the average score of intelligibility and clarity of the various items, setting a cut-off value of 0.3. Thanks to the analysis of the degree of clarity, we found out that the four-item turned out to be critical since their average scores were respectively below 0.3. At the same time, thanks to the analysis of the degree of intelligibility, we found out that a further eight items reported a low level of comprehension.

In conclusion, the questionnaire is made up of 36 items referring to three dimensions, where the behavioral mechanisms have been extended to catch those interpersonal behaviors. Because items present positive or negative aspects of the triadic structure, which can affect the goodness of decision-making at work, answers to every single item were given on a 7-point Likert scale where answers of respondents ranged from 1 = in a very bad way to 7 = in a very good way.

CONSTRUCT VALIDITY TEST

After having defined the scale, we started the validation process by administering it to our sample of 682 employees in the three multinational companies previously involved with the same survey methodology. The sample includes 316 females, with an age range between 20 and 62 years and an average of 32 years ($SD = 10.73$). Most participants work as clerks (61%), 28% as general workers, and only 6% are company managers. The present survey aims to test the construct validity of the instrument (ND) of its three expected latent components. We proceeded with a principal component analysis.

Table 1. Principal component analysis

Rotated factor matrix of the final Noise Decision (ND) inventory composed of 17 items and three components: interpersonal behavioral determinants, i.e., ND_IB (8 items), properties of the organizational environment, i.e., ND_OE (5 items), cognitive and analytical aspects, i.e., ND_CA (4 items)

Items	1	2	3
consideration showed by your supervisor [ND_IB_1]	.817		
the fact that your supervisor knows that your work is satisfactory [ND_IB_2]	.704		
being in a positive workplace [ND_IB_3]	.651		
an emotionally balanced atmosphere in the workplace [ND_IB_4]	.647		
presence of an attentive supervisor [ND_IB_5]	.590		
relaxed relations between you and colleagues [ND_IB_6]	.568		
being evaluated by your supervisor [ND_IB_7]	.522		
social support from your colleagues [ND_IB_8]	.521		
job tasks that need constant and intensive attention [ND_CA_1]		.761	
having to deal with some activities that need logical skills [ND_CA_2]		.722	
working on activities that need precision [ND_CA_3]		.611	
dealing with activities mentally straining [ND_CA_4]		.529	
too many job and organizational demands [ND_OE_1]			.580
bureaucracy annoyances of your organization [ND_OE_2]			.528
high workload [ND_OE_3]			.509
presence of fulfillments to do in your organization [ND_OE_4]			.459
working overtime [ND_OE_5]			.435

Note. $N = 381$, Extraction Method: Factor Analysis, Rotation Method: Varimax, Cut-off coefficient values $< .40$

On half of the total available sample, a principal-axis component analysis was conducted on the 36 ND items. The screen plot together with the acceleration factor method suggested the optimal number of factors to retain confirming a three structure has been hypothesized in the theoretical section. However, we also conducted a factor analysis with one, two, and four components in order to explore other interpretable solutions. Although some, however negligible, cross between loadings, the 3-factor solution was retained as the most acceptable model of interpretation. Six items showed a high cross-load between two factors (i.e., interpersonal behavioral determinants and properties of the organizational environment). Together with those that had low correlation among factors (11 items) and high frequencies of non-response (2 items), a final number of 19 items dropped from the remaining analysis, may indicate that such items were ambiguous or difficult to understand. When these items were subsequently deleted, the strength of the correlations uniformly increased. This deletion essentially had no effect on the internal consistency of ND (i.e., Cronbach's α , went from 0.80 to 0.79), nor did it bring about acceptable fit indices for the proposed three-factor model [Bartlett's test ($\chi^2 = 3851.85$ $p \leq 0.001$), Kaiser-Meyer-Olkin measure of sampling adequacy (0.80)] (see Table 1 for the items retained and factor loadings). As a result of this process, the final ND inventory was composed of 17 items with acceptable internal consistency estimates for its three components: interpersonal behavioral determinants, i.e., ND_IB (8 items; $\alpha = .84$), properties of the organizational environment, i.e., ND_OE (5 items; $\alpha = 0.65$), cognitive and analytical aspects, i.e., ND_CA, (4 items; $\alpha = 0.74$). Finally, based on the high item-total correlations, it seems that almost all the items within

each of the subscales are good indicators of the same underlying construct. On the other hand, none of the off-diagonal items presented correlations >0.90 , suggesting no evidence of multicollinearity.

STUDY II

PRESENTATION

The purpose of Study II is to validate the psychometric quality of ND by testing its discriminant and convergent validity with other measures for assessing decision-making qualities. We reported the main characteristics of such studies, such as participants, number of citations, authors, year of publication, abstract, reference theory, method, instruments, results, and discussion. For each study or scale taken into consideration, we looked for the items, categories, elements, selected behaviors, and technical indexes such as factor loadings and measures of internal coherence (see Table 1).

Currently, decision-making research, especially in applied areas, is extensively considering the use of within-subjects design studies for studying and assessing the different decisional skills (Bruine de Bruin et al., 2012; Weller et al., 2015). To date, researchers affiliated with the Society for JDM (SJDM, see <http://www.sjdm.org/>) have developed over twenty individual-differences psychometric measures, commonly used in judgment and decision-making research. Such inventories are mainly distinct in three large categories: the decision competence measures (i.e., assess how well individuals make decisions and whether they reach satisfactory outcomes) the decision approach measures (i.e., individuals' management of the decision process), and the decision style measures (i.e., measures relating to decision or cognitive style). The first category, based on decisional competencies, presents just a single psychometric questionnaire developed by Miller and Byrnes (2001) for measuring the so-called decision-making competency (DMCy). It relies on the Self-Regulation Model of Decision-Making (Byrnes, 2013), in which the competent decision-maker is characterized as a self-regulated individual, who uses inner metacognition processes to master decisions and examine the choice options that an environment has to offer. Moreover, self-regulation applied to decision-making is inseparably related to the management of environmental variables, since the individual cannot successfully adapt to the work environment until he/she develops a sense of control over some behavioral processes (Zimmerman & Bandura, 1994). This means that even a "so-called" competent decision-maker (i.e., an individual high in DMCy) could show preferences over sub-optimal choices since he/she lacks those coping strategies to overpower decision-making deficiencies given by harsh work conditions. For such a reason in the present study, the DMCy has been considered for testing the discriminant validity of ND.

Besides psychometrics applied to decision competence, the SJDM also proposes instruments based on the decision approach to assess the management of the decision-making, during, but also in the pre and post-stage of a decision. Such as the management of indecision – before – and of the regret – after – that a choice is made or is to make. Of interest for job-related psychological consequences in decision-making is the "regret feeling." The extent to which a person can experience regret can affect some self-regulatory mechanisms, such as the sense of depreciation, which can lower engagement at work. Regret-oriented people would also be more sensitive to external conditions during decision-making. We also tend to attribute to the environment the failure due to a bad choice and be more sensitive to external conditions during decision-making. As shown by Wood and Bandura (1989), individuals who perceive more regret after a decision is made, tend also to attribute to the environment the failure due to a bad choice, indicating bad management of external job resources. Indeed, there are several theoretical elements for examining the presence of a significant and negative relationship between ND and regret feeling. Furthermore, considering that ND is defined as the expression of the management of organizational elements, as a measure, it would belong to the same SJDM "decisional approach" category. On the other hand, whereas ND assesses those elements that can affect a process of choice, the regret scale belongs to those decisional approach tools which measure the sentiment following a decision.

The last category proposed by the SJDM is based on the assessment of the decision-making styles. An instrument particularly suitable for the work domain is the Career Decision-Making Style (CDMS). CDMS is used to describe the way that individuals collect, perceive, and process information at work throughout their decision-making processes (Phillips & Paziienza, 1988). The three styles detected by the instrument are rational, intuitive, and dependent. In particular, the rational style has been related to an approach to problem-solving, rather than avoidance of it, and has been related to greater self-regulation and to greater progress in the ability to make and implement reasoned decisions. Such “systematic-internals” individuals have been shown to be least likely to experience anxiety due to environmental uncertainty, thanks to their resolute ability to manage the decision process in complex environments. For such a reason, the rational decision-making style, compared to the other two (i.e., Int.28) might be related to Int.23.

Finally, we include other two instruments suitable for testing the convergent validity of ND, i.e., Career Decidedness (Lounsbury et al., 1999) and Career Decision Self-Efficacy Scale (CDSSES) (Betz, 2001). Both scales aim to assess the ability to complete successfully decision-making tasks work-related. Moreover, the two tools rely on self-efficacy and self-regulation Bandura concepts, defined as global confidence in one’s coping ability across a wide range of demanding or novel situations, which often characterize the organizational domain (Bandura & Jourden, 1991).

METHOD AND INSTRUMENTS

The respondents consisted of $N = 867$ subjects (54% female, average age 43 years). The majority of the sample have a high school degree (46%). Most participants work as clerks (65%).

Noise in Decision

To measure ND and its components (interpersonal behavioral determinants, properties of the organizational environment, cognitive and analytical aspects) the final version of the ND composed of 17 items was considered in the current study.

Decision-Making-Competency Inventory (DMCI)

The DMCI (Miller & Byrnes, 2001) has been used to assess three DMCI components. The DMCI scale has been created to assess some key aspects of decision-making skills by asking participants to report on their way of making decisions when they face important choices. Because of using it in the organizational domain, to the first part of the items (When I have a big decision to make ...) the expression “in the workplace” has been added. For the validation purpose, our attention was directed to the following sub-components: the person’s sense of self-determination in critically evaluating options (autonomy), self-appraisal, and information awareness.

Regret Scale

Five items of the Regret Scale were used to assess how individuals deal with decision situations after the decision has been made, specifically the extent to which they experience regret (Schwartz et al., 2002). Ratings were made on a 7-point scale (1 = completely disagree, 7 = completely agree). Moreover, the 13 items of the extended version with the maximization Scale were used to assess maximizing tendencies (e.g., “I’m always struggling to pick the best one”). Ratings were made on a 7-point scale (1 = completely disagree, 7 = completely agree). Higher scores indicated a tendency to seek the best option when planning.

Career Decision-Making Style (CDMS)

The CDMS was used (Phillips & Paziienza, 1988). The CDMS contains 30 items and measures individual styles of decision-making. For validation purposes, our attention was directed to the following sub-components: rational, intuitive, and dependent.

Career Decidedness

The measure of career decidedness chosen for this study was developed and validated by Lounsbury et al. (1999). The Career Decidedness scale is composed of six statements where respondents indicate their level of agreement based upon a 5-point Likert-type scale ranging from strongly disagree (1) to strongly agree (5). An example item is: “I have made a definite decision about a career for myself”.

Career Decision-Making Self-Efficacy (CDMSE)

Career decision self-efficacy was measured using the CDMSE scale short version (Betz et al., 1996) consisting of 25 items. Participants are asked to rate their confidence in completing a given task on a 5-level confidence continuum ranging from 1 (no confidence at all that I could) to 5 (complete confidence). Sample items on the scale include: “make a plan of your goals for the next five years”; “accurately assess your abilities”.

RESULTS

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was performed on the relationships indicated in the PCA on the second subsample and was conducted using software such as SPSS and AMOS. According to the literature, the factors considered for the analysis were TLI, CFI, and RMSEA (Hu & Bentler, 1998).

The first CFA performed on the three components found and based on a single factor configuration showed not-acceptable fit indexes: $\chi^2(124) = 195.342$ ($p < 0.001$), TLI = 0.928, CFI = 0.948, RMSEA = 0.052 (Cheung & Rensvold, 2002). Considering these first results, based on several indicators (e.g., Parallel Analysis screen plot, Velicer MAP, and BIC), we investigated the presence of a possible bi-dimensional structure. The second model that we tested considered all the previous subscales together through a bifactor model to verify if they underlie a single construct (ND). This resulted in an increment to an acceptable CFI value (Hu & Bentler, 1999) and an acceptable small increment of RMSEA value [$\chi^2(106) = 136.486$ ($p = 0.025$), TLI = 0.964, CFI = 0.978, RMSEA = 0.037]. In conclusion, the instrument validated is made up of 18 items referring to three dimensions (i.e., Social skills, Emotional skills, Cognitive skills) composed of six items each and the six constructs with respective items.

Based on the last ND structure, Table 2 reports the means, standard deviations, correlations, and internal consistency indexes of the inventory in relation to sociodemographic variables. As can be seen, the ND subscales are not reciprocally highly correlated, confirming independence in measuring three distinct decision-making skills. In relation to socio-demographic variables, ND shows a positive correlation with the number of supervised staff ($r = 0.15$, $p < 0.01$). Table 2 presents means, standard deviations, internal consistencies, the number of respondents for each scale, and correlations between ND and the other decision-making measures.

Table 2. Means, standard deviations (SD), internal consistencies (on the diagonal), number of respondents (N) and correlations among socio-demographics and study's variables

Variables and N	M(SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ND interpersonal (867)	5.80(0.78)	(0.85)													
2. ND cognitive (867)	4.70(1.10)	.29**	(0.74)												
3. ND organization (867)	3.54(0.93)	.00	.34**	(0.67)											
4. ND total (867)	4.90(0.61)	.74**	.72**	.57**	(0.80)										
5. DMGy information awareness (592)	4.06(0.87)	.06	.10*	-.08	.04	(0.76)									
6. DMGy self-appraisal (592)	3.38(0.55)	.16**	.04	-.18**	.03	.58**	(0.82)								
7. DMGy autonomy (592)	3.72(0.46)	.25**	.13**	-.08*	.18**	.10*	.14**	(0.78)							
8. maximization (154)	3.78(1.42)	-.03	.12	-.15	-.05	-.20	-.30*	-.01	(0.75)						
9. regret (154)	3.81(1.17)	-.18*	.06	-.02	-.11	-.23	-.38**	.22	.48**	(0.79)					
10. CDMS intuitive (199)	3.64(0.96)	-.04	.04	.07	.00	—	—	—	.42**	.17	(0.87)				
11. CDMS rational (199)	4.92(1.01)	.34**	.23**	.07	.31**	—	—	—	.13	.13	.02	(0.90)			
12. CDMS dependent (199)	2.94(1.05)	-.10	-.17*	.00	-.14	—	—	—	.48**	.51**	.37**	-.05	(0.92)		
13. CDMSE (117)	3.44(0.55)	.20*	.46**	.38**	.44**	—	—	—	—	—	-.07	.27**	-.29**	(0.87)	
14. Career Decidedness (115)	3.18(0.91)	.11	.24**	.38**	.30**	—	—	—	—	—	.00	.26**	-.31**	.57**	(0.89)

* $p < 0.05$. ** $p < 0.01$

The results show low correlations between ND and DMCy components, confirming the discriminant validity of ND. High correlations instead with CDMSE and Career Decidedness proved a good convergent measure with self-regulation constructs related to decisions in the work/career domain (CDMSE: $r=0.44$, $p<0.01$, Career Decidedness: $r=0.30$, $p<0.01$). The CDMS rational component and the Regret scale present a significant correlation with some ND components (ND interpersonal/CDMS: $r=0.34$, ND cognitive/CDMS: $r=0.23$, $p<0.01$, ND interpersonal/Regret scale: $r=-.18^*$, $p<0.05$). This is usually found when using scales aimed to measure decisional competence (Parker et al., 2007). In general, ND components show a different response in relation to the singular decision-making scales considered. Overall, these differences are not divergent between them in terms of directions with the general behavior of the other ND subscales. In the end, we report that consistent with Parker et al. (2007), self-reported maximizing is related to less behavioral coping, and more depending on others. Replicating a key result from Schwartz et al. (2002), we also confirm that people who reported stronger commitments to maximize also reported experiencing greater regret. Consistent evidence has been found on the performance between tasks involved in some biases and different cognitive ability measures. Stanovich (1999) has deeply contributed to the role of individual differences in H&B.

DISCUSSION

PURPOSES

By now, most people know the ways in which biases can creep into important decisions. However, according to psychology and strategy experts most are far less aware of how noise can influence their choices. In this case, noise does not refer to the din in the room, but to the high variability of inputs and cognitive processing that people must deal with when making individual and collective judgments (Kahneman, Sibony, Fusaro, & Sperling-Magro, 2021). As we have seen, noise is a quite new and unexplored concept that strictly connects with system 2 of reasoning. We have defined it as the unwanted variability in professional judgments, added to the systematic error, which is cognitive bias, affecting system 1. For this reason, noise is a topic of interest at present in many fields, as it may not only compromise estimates, diagnoses, trials, and any kind of performance, but also their implementation. The gap in the literature about noise is surely justified by the newness of the matter, but it needs to be filled for future applications in improving the quality of judgments. This paper aimed at proposing a novel instrument for the assessment of noise in different work environments, keeping in mind the relevance it may have in the contemporary background, where the number of people involved in judgments and decisions is constantly increasing. The construction of our tool started based on a list of items generated through qualitative interviews, and subsequently, the psychometric model has been revised. Given these two phases, two separate studies have been conducted, the first of which concerns the data collection for the item generation and quantitative selection of principal components of the inventory. Overall, the internal reliability estimated for each of the ND subscales was acceptable and the correlations among the subscales were relatively low, suggesting that ND well measured the three distinct components mentioned. Our findings suggest that two of these components (i.e., properties of the organizational and cognitive and analytical aspects) are particularly sensitive towards the environmental aspects relevant to decision processes, which in turn influences well-being. This paper is firstly meant at improving theory and research on decision-making. Moreover, potential implications may be that being able to detect and restrict noise with a systematic method could improve both the quality of decisions and the quality of the thinking processes.

STUDY I

Of the two studies, the results of the first one provided substantial evidence of the Noise in Decision Inventory: among 36 analyzed items, a total amount of 17 have been selected to compose the scale. We first used a qualitative approach via semi-structured interviews with organizational decision-makers. The results of the semi-structured interviews led to an abundant list of work characteristics that

may affect the decision-making processes: at this point, the list was composed of 48 key statements, collected by considering the frequency and aggregating the most similar ones. Then, a pilot questionnaire was made to test the intelligibility and clarity of the set of items, and so a Q-set data has been created. With these data put in a contingency matrix, we could perform a Multiple Correspondence Analysis (MCA) that showed 87% of cumulative inertia. Therefore, the items were confirmed by applying the Q-sort test, and the list has been reduced to 36 because of a low clarity of 3 items and low comprehension of further 8 items. After that, the generation of the item has been pursued through a Principal Component Analysis, which led to an ulterior thinning of the most salient environmental factors: 6 items were not valuable because they showed high cross load between two factors; 11 items were discarded due to low correlation; 2 items had high frequencies of non-response. In conclusion, the PCA detected a significant correlation on 17 of the 36 items, which now compose the inventory pursued (ND).

The second study aimed to empirically test the psychometric instrument developed in the first study, by showing consistency among different validity tests (comparisons with other existing scales and subsequently a CFA) and confirming its psychometric goodness based on three facets: i.e., interpersonal behavioral determinants, properties of the organizational environment, and cognitive and analytical aspects.

STUDY II

Study II provided the validity of the developed scale through the CFA and the convergent and discriminant validity test. The validation of the psychometric qualities of the ND made it possible to affirm that the influence of noise is present in decision-making within the context of work environments, validating the initial intentions of this project. First, we carried out CFA to test the 3-factor structure of the ND. Due to the presence of unacceptable indices, we used a two-dimensional structure. In fact, the second model we tested considered all the previous subscales together, using a bifactorial model to verify if they are the basis of a single construct (ND). This resulted in an increase to an acceptable CFI value and a small acceptable increase in the RMSEA value. In conclusion, the CFA confirmed the three-structure model of the ND (i.e., social skills, emotional skills, cognitive skills). Lastly, we proceeded with testing the convergent validity of the ND through the positive correlation with the number of supervised personnel. It also emerges that the results show low correlations between ND and the DMCy components, thus confirming the discriminant validity of ND. On the other hand, high correlations with CDMSE and Career Decidedness turned out to be a good convergent measure with the self-regulation constructs related to the decision in the job/career domain. In general, the ND components show a different response in relation to the individual decision scales considered.

LIMITATIONS

The study carried out has some limitations that are to be taken into consideration for future research projects. The study follows the typical lines of cross-sectional studies. The primary limitation is that because the exposure and outcome are simultaneously assessed, there is generally no evidence of a temporal relationship between exposure and outcome.

Another limitation is to be found in the use of semi-structured interviews because this type of interview leaves little space for the interviewee's narration or free expression.

Finally, it is important to consider the self-selection bias since the participants volunteered for both studies. If those who do not participate have a significantly different opinion than those who decide to participate, the self-selection bias can cause an overestimation of customer satisfaction. We could have paid the participants to solve the problem of overestimation, but a bigger problem would have emerged: the participants might not have been adequately motivated, and they might give answers that are not entirely relevant.

RESEARCH AND PRACTICAL IMPLICATIONS

Research implications

Given the ND measurement, the inventory can be a starting point for future research about noise: as Kahneman, Sibony, and Sunstein (2021) stated, their work on system noise was somewhat premature due to the lack of existing literature on the subject. The creation and validation of a statistically valid inventory to detect and measure noise is an important contribution to the decision-making literature. As the first and only scale for measuring noise, it provides a valuable starting point for future research in this area. System noise has been tested by Kahneman and colleagues with a “noise audit”, which consists of subjecting the same problem to different people and measuring the differences in their responses. By using the audit in conjunction with the ND inventory in the specific work environment, researchers can better understand the influence of noise in the organizational context. This could be helpful to detect noise and measure its impact as well, building a clearer picture of the circumstances in which noise is most likely to occur and its impact on the quality of decision-making. Furthermore, this article enriches the existing literature by highlighting the importance of considering environmental influences on decision-making. Overall, this research has important implications for future research and practice in the field of decision-making.

Practical implications

The application of the ND inventory in organizational contexts has many practical benefits, such as determining the quality of managerial decision-making strategies, but also to improve the effectiveness of group decisions. Specifically, the inventory can be used as a tool to arrange educational interventions for workers, such as training programs that help individuals recognize and mitigate the effects of noise in decision-making. It can also aid in the establishment of an effective partition of tasks, mansions, and roles in the organization, as it identifies sources of noise that may interfere with decision-making processes. Additionally, the inventory can serve as a reliable guideline when decisions appear to be a source of risk, as it provides a systematic and objective method for evaluating decision-making quality. Overall, the noise detection inventory has practical implications for improving decision-making processes in organizational contexts, leading to better outcomes and increased success.

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AUTHORS



Sara Bollarino works in the International Area of Enaip Veneto as a project officer. She has a master's degree in Work, Organizational, and Personnel Psychology, and collaborates as an intern researcher with the Department of Human Sciences, University of Verona.



Andrea Ceschi is an Associate Professor in Work and Organizational Psychology (WOP) at the Human Sciences Department of Verona University. Co-Founder and Scientific Director of the research centre APRESO (Applied Research in Society and Organizations), his expertise lies in organizational behaviour, individual differences and decision-making at work, and social dynamics in the applied psychology field.



Michele Monti has a master's degree in Work and Organizational Psychology. He earned his Master's degree in Psychology for Training from the University of Verona, with a thesis that examined the strategic disclosure in the field of Human Resources. He collaborates as a research collaborator and communication assistant with the Verona University Centre of Research APRESO. His area of interest is in dissemination and digital communication on the topics of Work and Organizational Psychology.



Riccardo Sartori is an Associate Professor of work and organizational psychology at the Human Sciences Department of Verona University. He is a psychologist and psychotherapist, who graduated in Work and Organizational Psychology, Ph.D. in Perception and Psychophysics. His interests focus on: (1) assessment of candidates and personnel (individual, group, and organizational assessment); (2) training and development of human resources; and (3) business consulting dealing with organizational dynamics (organizational co-habitation, cooperation, conflict, etc.). He is the Director of the research centre APRESO (Applied Research in Society and Organizations).