

## RESEARCH ARTICLE

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# Psychological Assessment Reports in Selection Decisions: The Role of Spatial Contiguity Principle

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### Abstract

Two ways of building psychological assessment reports were explored in two separate quasi-experimental studies. In the first study, depending on their assigned experimental group, participants received either an integrated or a spatially distant type of report. They were subsequently invited to choose, based on the reports and a corresponding job description, the better candidate for a fictitious job, out of two options. The obtained results suggest that there is no significant difference between the two groups. Thus, the way in which the reports were structured did not influence in any way the participants' decision. For the second experiment, which had a similar approach, an eye-tracker was used. Participants were asked to solve the same task, while their eye movements were recorded. The only significant between-group difference was in regards to the integrated transitions the participants made between the graphic and the text. No significant difference was observed regarding the number of fixations or the duration of fixations between the two groups. Based on these results, we argue that the two contrasted ways of building an assessment report do not influence the accuracy of decisions made.

### Keywords

psychological reports, psychological report design, personnel selection, cognitive psychology, spatial contiguity principle, eye-tracking methodology

This paper addresses the issue of developing psychological assessment reports, from the perspective of cognitive ergonomics. In organizational contexts, selection and personnel development decisions are subsequent to assessment processes, typically based on assessment reports. Despite this topic being neglected by the scientific literature at large, the way in which reports are built is as important as the assessment process itself, and arguably falls under the direct responsibility of test developers. The negative effects of a psychological report that does not

communicate critical information in a compelling way and therefore leads to poor hiring decisions are just as bad as the case in which the evaluation tools themselves are not methodologically sound: ultimately in both cases decisions are based on incomplete or erroneous information.

The way people are presented information strongly influences their decision-making processes, from the manner and amount of involvement they exhibit, to the potential errors that may arise; these effects are highlighted by multiple studies (Ariely, 2000;

Bonnardel, Piolat & Le Pigot, 2011; Lurie & Mason, 2007). Although this effect is easily visible, the mechanism by which it occurs is not yet fully understood (Kelton, Pennington & Tuttle, 2010). While these studies are focused primarily on testing multiple ways of building websites, their conclusions may also be applied to building assessment reports.

Psychological reports can be structured in a variety of ways, as there is no standard in this respect: they can include either text or graphics, or a combination of text and graphics; they may be colored or black-and-white, descriptive or behavioral, etc. Aside from visual attractiveness, how well are they built to be effective in selection decisions? Unfortunately, we did not identify a single study in the literature that would address this issue. Moreover, the literature is also poor in terms of explanatory mechanisms about how people make such decisions, specifically on how they go about choosing between two alternatives. Payne observed, in 1976, that the mathematical models developed so far to explain decision-making behavior have been shown to have a large number of drawbacks. All the proposed models have received some empirical support, but none of them represents a fully satisfactory explanatory model. This lack of consensus was also emphasized by the fact that later research almost completely ignored choice behavior, focusing either on the study of strategic decisions (e.g., Beusenitz & Barney, 1997), or on bounded rationality theory, as proposed by Kahneman and Tversky (e.g., Levy, 1997).

Therefore, considering the above-mentioned arguments regarding the effect of the presentation of information on individual behavior and decision making, and the lack of studies in the scientific literature on the design of psychological reports, the aim of this paper is to evaluate the efficiency of two ways of structuring an assessment report that includes both text and graphics. To this effect we have drawn upon two cognitive theories that help underpin a rational approach to our research question: cognitive fit theory and cognitive load theory.

## **Cognitive Fit Theory**

Studies based on this framework have demonstrated that there must be a match between the task and the task representation (Dunn & Grabski, 2001; Hong, Thony & Tam, 2004). Furthermore, the way in which the task is represented affects the mental processes involved in its realization (Kelton et al., 2010). When such a match exists, a consistent and accurate representation of the problem is formed in the working memory, and this results in better performance. Instead, when there is no match, people have to apply extra cognitive effort to mentally transform the representation of the problem into a construct that suits its ways of solving it. Lack of cognitive matching will lead to bad decisions and/or increase the time needed to solve the problem (Kelton et al., 2010; Speier, 2006).

Research based on this theory was focused mainly on studying how the specificity of a problem dictates whether its representation should be made using either graphs/charts or tables, the two approaches having a different influence on performance (Speier, 2006). Tasks that require comparing data and understanding relationships are better processed when represented by graphs (Hard & Vanecek, 1991), and tasks requiring only the use of discrete data values are better processed with tables (Amer 1991). By extrapolation, decisions based on assessment reports may be easier to process when information is represented by graphics and not by tables.

A number of studies argue that processing and learning are easier when information is presented in a form that combines text and graphics (Butcher, 2006; Mayer, 2009; Moreno & Mayer, 2005). Experimental studies on this topic have demonstrated that using graphics supplementary to text improves performance by more than one standard deviation (Fletcher & Tobias, 2005; Mayer 2009). Also, the presentation of information in a combination of text and graphics has an effect not only on the retention of information but also on profound understanding (Sung & Mayer, 2012), which then reflects in better problem-solving skills (Mayer 2002, 2009). This may be due to the fact that graphic representation complements the limitations of

representing information exclusively through text, summarizing its essence (i.e., macrostructure) and reducing the mental effort that individuals have to invest (Lim & Benbasat, 2002). Moreover, the human mind uses two information processing channels, one for verbal information processing – written or spoken, and one for processing information in the form of images – static or dynamic (Mayer 2009). Structuring the material in the form of text and graphics thus takes advantage of both of these channels, using an individual’s whole cognitive capacity.

To summarize, cognitive fit theory states that there must be a certain match between the actual task and its representation, and that this correspondence reduces the mental effort that a person invests when interacting with the material; structuring assessment reports in a combined form of text and graphic should be more effective for cognitive processing.

### **Cognitive Load Theory**

The second theory underlying this work has as its main objective the reduction of cognitive load and cognitive effort, and builds on the fact that working memory has a limited capacity (Baddeley, 1992; Sweller, Merriënboer & Paas, 1998). Because too many elements can overload working memory and negatively impact information processing, cognitive load theory can be used to guide information structuring in such a way that cognitive performance is not impaired. According to cognitive load theory, three sources of cognitive load could overload working memory and prevent learning (Ginns, 2006; Sweller & Chandler, 1994): intrinsic cognitive load, extraneous cognitive load and germane cognitive load.

Intrinsic cognitive load refers to the degree of interactivity between the elements of a complex stimulus and the complexity of the information to be processed (Florax & Ploetzner, 2010; Ginns, 2006). In other words, in the case of complex materials, elements cannot be understood in isolation from each other and will involve a high consumption of working memory resources. On the other hand, materials with low complexity allow learning without significant consumption of

resources, as their elements can be understood in isolation. We note in this context that the degree of complexity of a stimulus cannot be fully assessed objectively; the evaluation depends to some extent on the familiarity people have with it (Speier, 2006).

Extraneous cognitive load prevents learning and the forming of cognitive schemes in long-term memory, and arises from the way information is presented (Paas, Renkl & Sweller, 2004). An inappropriate presentation leads to an unnecessary use of cognitive resources. This can also be explained through the precepts of cognitive fit theory presented above – when the representation of the task is not appropriate with the task itself, mental effort requirements increase.

Germane cognitive load refers to the active processing people display towards learning. Although the conceptualization of cognitive load into three elements has received support over time, recent conceptualizations (Paas & Sweller, 2014; Schroeder & Cenkci, 2018; Sweller, Ayres & Keluga, 2011) suggest abandoning this type of cognitive load, because of high overlap between the germane and intrinsic cognitive load. Some researchers suggested replacing this label with “relevant resources” (Kalyuga, 2011).

To summarize, according to cognitive load theory, the level of intrinsic and extraneous load should not exceed working memory capacity. Considering the specific level of intrinsic load of a given material, an increase in the extraneous cognitive load will lead to a decrease in the capacity of working memory, and thus to lower performance (Ginns, 2006).

### **Practical Conclusions for Report Design**

In light of these theoretical frameworks, how should psychological reports be structured so as to ease the cognitive work of readers? Several design principles have been suggested, including the split attention principle and the spatial contiguity principle. The two are relatively similar, and in essence state that materials are easier to process when the parts describing the same information are spatially close to one another (Ayres & Sweller, 2014; Holsanova, Holmberg &

Holmqvist, 2008). The first principle derives directly from cognitive load theory, while the second was proposed by Moreno and Mayer (1999) as the essence of the cognitive theory of multimedia learning. Given that the split attention principle was also used in order to refer to the segmentation of the material over time, not just spatially, Moreno and Mayer suggested replacing it with two other terms, respectively - the spatial contiguity principle and the temporal contiguity principle (Schroeder & Cenkci, 2018).

The spatial contiguity principle postulates that people make more cognitive effort to process a material when related information is separated by space (Moreno & Mayer, 1999). This effect has been demonstrated in numerous studies (e.g., Cierniak, Scheiter, Gerjets, 2009; Craig, Twyford, Irigoyen & Zipp, 2015; Mayer & Fiorella, 2014), and their conclusions were mostly in the same direction: it is easier to learn when dealing with an integrated material, especially when the material is complex (Ginns, 2006). Two meta-analyses offer a general picture of how this principle works (Ginns, 2006; Schroeder & Cenkci, 2018), reporting effect sizes of  $d = 0.72$  and  $g = 0.80$ , respectively. Unfortunately, no study included in these meta-analyses aimed to test the effectiveness of an integrated material in a decision-making process; research was exclusively carried out in learning tasks, so that it is not very clear how the principle of spatial contiguity is applied to other types of tasks.

Our study aims to address this limitation and gap in the literature in two separate experiments, both with the intention of expanding the above-mentioned theories in the field of decision-making, as well as building scientific evidence on the effective ways of constructing an assessment report. Considering this objective, two ways of building a report will be tested: (a) an integrated form, where the graph and its explanations are spatially close to one another, and (b) a spatially distant form, where the graph and text are presented separately on the page. For the first experiment, we forward the following hypothesis:

*H1: The proportion of people making the right decision based on an integrated material is significantly higher than the proportion of*

*people making the right decision based on the spatially distant material.*

## **Eye-Tracking Methodology and the Spatial Contiguity Principle**

The second experiment addresses the principle of spatial contiguity through the use of an eye-tracker. Eye-tracking methodology has been commonly used in various domains, such as the film industry (e.g., d'Ydewalle & Gielen, 1992; Holsanova et al., 2009) and has recently been adopted in the handling of multimodal materials, especially in learning tasks (e.g., Ozcelik, Arslan-Ari & Cagiltay, 2009). In organizational settings, eye-tracking methodology is still rarely used (Meißner & Oll, 2019). However, recent studies started to embrace this methodology, but most of them are in the marketing area (e.g., Bigne, Llinares & Torrecilla, 2016; Wastlung, Otterbring, Gustafsson & Shams, 2015).

Eye movement pattern is an indicator of the cognitive processes people perform during tasks (Ozcelik et al., 2009). For example, as a general rule, fixations can be interpreted as indicators of cognitive load; twice as many fixations in a certain area of the page can be translated as twice as much cognitive effort exercised (Duchowski, 2007). However, as Duchowski observed, this assumption is not always true. It is possible that the participant may be bored or entertained, or simply staring blankly. It is also possible that the fixations in a certain area can be explained by the complexity of the material; complex materials require increased attention in those areas that are more difficult to understand. In spite of these limitations, eye tracking methodology is an objective measure of cognitive processing (Johnson & Mayer, 2012), and constitutes an important aid in understanding cognitive processing, as well as in formulating explanatory mechanisms for already demonstrated effects, such as the spatial contiguity effect (van Gog & Scheiter 2010).

A number of studies aimed to record eye movements as a means of explaining how integrated materials lead to better learning, compared to spatially distant materials; they concluded that participants who were offered an integrated material had significantly more transitions of integration between graphs and

text (Holsanova et al., 2009) and had significantly more graph fixations (Schmidt-Weigand, Kohnert & Glowalla, 2010), and these two aspects led to better task performance.

Based on these findings, the aim of our second experiment is to explain and qualify the results obtained of the first experiment, by using eye movement patterns. For this purpose, three variables relevant for cognitive processing were analyzed - the duration of the fixations on the graph, the number of fixations on the graph and the number of integrations between the graph and the text. The following hypotheses were formulated:

*H2: The length of fixations on the graph will be higher for an integrated design than for a spatially distant design.*

*H3: The number of fixations on the graph will be higher for an integrated design than for a spatially distant design.*

*H4: The number of integration transitions will be higher for an integrated design than for a spatially distant design.*

## Experiment 1

Experiment 1 aimed to test the principle of spatial contiguity in a task involving two different assessment reports, where participants had to select the more suitable candidate for a job. In accordance with cognitive load theory and the spatial contiguity principle, we formulated the hypothesis that people tend to perform better in the task (i.e., correctly selecting the right job candidate) when handling an integrated report, compared to the situation in which they received a report with spatially distant components. This is because processing a segmented material requires more cognitive effort, which will lead to an overload in working memory and, further, to a high consumption of cognitive resources. Thus, when people will have to perform the actual task, many of their cognitive resources will have already been depleted. On the other hand, processing an integrated material does not raise such problems, space contiguity coming to the aid of a limited memory capacity.

## Methods

### Participants

The sample consisted of 110 participants, out of which 74.5% were women ( $N = 82$ ) and 25.5% men ( $N = 28$ ), with an average age of 29.71 years ( $SD = 9.5$ ). Mainly students with interests in the area of organizational psychology (68.2%) were targeted, as well as some participants with practical experience in this field (38.2%). Of those with work experience, the sample included: teachers ( $N = 9$ ), entrepreneurs ( $N = 2$ ), psychologists ( $N = 11$ ), human resources specialists ( $N = 3$ ), consultants ( $N = 4$ ), career counselors ( $N = 1$ ) and research assistants ( $N = 1$ ).

The sample was based on convenience sampling: invitations to participate in the study were handed out in a national conference of industrial-organizational psychology, as well as between students attending undergraduate classes in a faculty of psychology.

### Instruments

The study assessed how the design of a report influences task performance in a decision task. Participants received either an integrated or a spatially distant assessment report (depending on the experimental group in which they were distributed) and were asked to choose, based on those reports and a job description, the candidate most suitable for the job. The two design types of the material represented the independent variable of the study, measured on a dichotomic scale – *integrated design* versus *spatially distant design*. The dependent variable was represented by the accuracy of the decision, also measured on a dichotomic scale – the *correct answer* versus *the wrong answer*.

### Procedure

The experimental stimuli used in this study were the two types of psychological reports mentioned above. For each type of design, two reports of two different candidates were built, based on the Occupational Personality Questionnaire (Bartram, Brown, Fleck, Inceoglu & Ward, 2006).

The reports have been structured in such a manner as to have an objectively correct and wrong decision, and to have not-so-obvious differences between the two candidates. To this effect, we divided the job description into main activities (e.g., budget management) and secondary activities (e.g., checking of promotional materials). The personality traits of the OPQ questionnaire were also divided into features that candidates should have (e.g., coordination, persuasion) and features that candidates would be preferable to have (e.g., adaptability). In this context, the profile of the first candidate (representing the right choice) was designed to show high scores on some important features and average scores on other important features. The profile of the second candidate was built in the opposite way – it had high scores on the features the first candidate scored average at, and average scores on the others. The same principle was used for the less important features for the job. The scale scores in the report were validated and confirmed by five experienced consultants, all agreeing on the right decision. In order not to influence the participants' decisions, neutral English names were used to differentiate the two fictional candidates (e.g., Alex and Ellis).

The two reports were each structured as an integrated design (Experimental Group 1) or in a spatially distant design (Experimental Group 2). The integrated design implied a spatial approach between the graph and the related explanations, so that in the middle of the page there was a bar graph, and on the left and right there were the behavioral descriptions for each scale, for a small to a large score, respectively. The spatially distant design implied the use of the same chart type and the same information in the text, yet the text was entirely positioned below the graph. In order not to influence the participants, the reports did not contain any clues about the hierarchy of the two candidates (e.g., 1 or 2), and fictitious names were used to differentiate them. Participants were randomized into

Experimental Groups 1 and 2 by extracting a ticket. Subsequently, they received the job description for the role of *Advertising and Promotions Manager* as well as the reports for each experimental group. In order not to influence the decision, the order in which the participants received the reports was random. Also during the training, participants were told that any other relevant workplace features other than those in the OPQ reports were equivalent between the two candidates. The task was timed, each participant having eight minutes to read the job description and select the right person. The time limit was chosen following a pilot test before the study was implemented.

### Analysis

For the analysis of the collected data, the chi-square test of association was used; the right or wrong decision participants made was associated with the experimental group they were part of (integrated design or spatially distant design). Using the Cochran-Mantel-Haenszel test, we also controlled for two confounded variables, which could have influenced the results: (a) the extent to which participants were familiar with the OPQ; and (b) their experience in hiring decisions based on assessment reports.

### Results

Table 1 displays the number and percentage of participants in each group. One of the experimental groups included 58 participants, 34 of whom responded correctly (58.6%) and 24 responded incorrectly (41.4%). In the other experimental group, 52 participants were included, of which 30 responded correctly (57.7%) and 22 responded incorrectly (42.3%). Irrespective of the experimental group they participated in, 64 of the participants selected the candidate correctly, and 46 of them made the wrong decision.

Table 1. *Number and Percentage of Participants for Each Group*

Design Type	Decision		Total
	Correct	Wrong	
Integrated	34 (58.6%) (.0)*	24 (41.4%) (-.1)*	58
Spatially distant	30 (57.7%) (.0)*	22 (42.3%) (.1)*	52
Total	64	46	110

Note. \* = Standardized residual values.

The chi-square test was used to test the association between report type and the right hiring decision. All expected frequency values were greater than 5, the lowest value being 21.75. The data related an insignificant association between the two variables,  $\chi^2(1) = 0.10$ ,  $p = .921$ . The effect size was not significant either,  $\eta^2_c = 0.009$ ,  $p = 1.000$ .

We also tested two confounded variables which could have influenced the results: the

extent to which participants were familiar with the OPQ instrument and their experience in decision making hiring based on assessment reports. For this purpose, the Cochran-Mantel-Haenszel test was used. The data did not support the effect of either of the two covariates,  $\chi^2(1) = .005$ ,  $p = .944$ , and  $\chi^2(1) = 0.005$ ,  $p = .946$  respectively (Table 2).

Table 2. *Covariate Control*

	Decision*Familiarity OPQ			Decision*Experience with reports		
	Chi-Squared	df	Asymptotic Sig.	Chi-Squared	df	Asymptotic Sig.
Mantel-Haenszel	.005	1	.944	.005	1	.944

Note: df = degrees of freedom

In order to compute the study power, a post hoc analysis was run, yielding a power of 0.05. Therefore, we can conclude that the study was underpowered.

## Discussion

We conclude that our research hypothesis was not supported by the data – there was no significant difference between the participants who made the hiring decision on the basis of an integrated report versus those deciding based on a spatially distant report. Moreover, almost half of the participants ( $N = 46$ ) selected the wrong candidate, regardless of the group they were part of. Furthermore, the results could not have been influenced by the interference of covariates within the design, their effect being statistically insignificant.

## Experiment 2

The second experiment was a proof of concept study, aiming to explain the results of Experiment 1. For this purpose, eye movements were recorded using an eye-tracker. According to the scientific literature, the way people visually approach the task can be an explanatory mechanism of performance in that task. In the context of spatial contiguity, previous studies have demonstrated that integrated materials facilitate both the number of integrations between graph and text, and the focus on information in the graph.

## Methods

### Participants

For this experiment, data were collected from a convenience sample of 37 participants, however only those who got at least a 70% data

entry record were included in the statistical analyses. Consequently, 5 participants were excluded. Another participant was excluded from the analysis due to the fact that it was an outlier. The final sample ( $N = 31$ ) comprised 5 men and 26 women, with a mean age of 24.47 years ( $SD = 4.71$ ). Participants were either graduates ( $N = 4$ ), graduate (Master) students ( $N = 24$ ) or third year undergraduate students ( $N = 3$ ) in a faculty of psychology.

## Instruments

For this experiment, the design type of the report (integrated or spatially distant) represented the independent variable, and the measurements related to participant eye movements represented the dependent variables: the length of their fixations on the graph, the number of fixations on the graph and the number of integrations. The duration of the graph fixations was measured in seconds and represents the total number of seconds each participant spent in analyzing the graph. The number of graph fixations is provided by aggregating the number of glances pointing to the same area of the graph. The number of transitions between the text and the graph represents the total times when the participants have moved their eyes from the text to the graph, and vice versa. The first two variables are indicators of the selection, and the third variable is an indicator of the integration of information. Eye movement data were collected using a Tobii Eye tracker 2150, owned by the Faculty of Sociology and Social Sciences, University of Bucharest.

## Procedure

Similar to Experiment 1, two reports were built based on the Motivation Questionnaire (MQ; SHL 1992, 2002). A short version of the MQ report, adapted to this research, was used, and it included only eight scales out of 18. The decision for this shortening was based on the low resolution of the Tobii screen (1024 x 640), which made it impossible to read a larger report on the screen. Similar to Experiment 1, the two reports were structured in an integrated form (Experimental Group 1) and in

a spatially distant form (Experimental Group 2).

Participants were given the same job description for the role of *Advertising and Promotions Manager* and two integrated or spatially distant design reports, depending on the group they were part of. The participants were randomized into the two groups with the help of a random generator. In this experiment, the two reports appeared on the screen side by side, the program not allowing a randomization of their order. All participants had the candidate's report representing the wrong choice on the left-hand side of the screen, and the correct candidate's report to the right side of the screen. Each participant had 75 seconds to select the right person, a pre-determined test time. In order not to influence the participants' decisions, neutral English names were used to differentiate the two fictional candidates (e.g., Jamie and Charlie).

## Analysis

Prior to the actual statistical analysis, the key areas of interest (AOI) were delineated with Tobii Studio. In defining these AOI, both reports displayed on screen were taken into account. There were two areas of interest for the graphical portions and two areas of interest for the text portions, covering together about 66% of the total screen. The data from these corresponding areas were aggregated as an average of the two. Based on these data, three variables were analyzed: the duration of fixations (measured in seconds), the number of fixations and the number of integrations. The chi-square test of association was used to verify whether there is a significant difference between the two groups in terms of the correctness of the decision. Following this step, the three hypotheses of this experiment were tested using the *t* test for independent samples.

## Results

Within one of the experimental group ( $N = 15$ ), six participants responded correctly and nine responded with the wrong decision. In the other experimental group ( $N = 16$ ), 11 participants responded correctly and five

responded with the wrong decision (Table 3). To test the association between the design type and the right hiring decision, the chi-square

test of association was used. All expected values were greater than .5, the lowest being 7.2.

Table 3. Number and Percentage of Participants in Each Group

Design Type	Decision		Total
	Correct	Wrong	
Integrated	6 (.8)*	9 (.9)*	15
Spatially distant	11 (.8)*	5 (.8)*	16
Total	17	15	32

Note. \* = Standardized residual values.

Data revealed an insignificant association between the two variables,  $\chi^2(1) = 3.13$ ,  $p = .156$ . The effect size was also not statistically significant,  $\eta^2 = 0.31$ ,  $p = .156$ . We also computed a study power post hoc analysis, yielding a power of 0.22. Therefore, we can conclude that the study was underpowered.

eye movement. Extreme values ( $N = 1$ ) were eliminated, following an examination of the boxplot. Also, all three dependent variables were analyzed for a normal distribution of data using the Shapiro-Wilk test ( $p > .05$ ). The means and standard deviations of the eye-tracking measurements for the two experimental groups are available in Table 4.

The  $t$  test for independent samples was conducted in order to analyze differences in

Table 4. Mean and Standard Deviations for the Associated Variables, and Independent Sample  $t$  Test Results

	Design type				$t$	df	Sig.	Mean Difference	95% CI	$d$
	Integrated		Spatially distant							
Eye-tracking Measures	M	SD	M	SD						
Length of graph fixations	12.40	5.32	13.10	8.27	-.27	29	.784	-0.69	[-5.84, 4.45]	0.1
Number of graph fixations	38.66	15.72	33.09	19.8	.86	29	.395	5.57	[-7.62, 18.77]	0.3
Number of integrations	62.33	15.40	38.75	14.08	4.45	29	.000	23.58	[12.75, 34.41]	1.59

Note:  $M$  = mean,  $SD$  = standard deviation,  $df$  = degrees of freedom,  $sig$  = significance,  $CI$  = confidence intervals

Considering the results of the  $t$  test, the data only supported the fourth hypothesis:  $t(29) = 4.45$ ,  $p = .000$ . According to this result, participants from Experimental Group 1 made more integrated transitions between graph and

text ( $M = 62.33$ ,  $SD = 15.40$ ), compared to Experimental Group 2 ( $M = 33.09$ ,  $SD = 19.8$ ). The recorded effect size between the two variables was high,  $d = 1.59$ . Concerning the other two hypotheses (regarding the duration

and number of fixations on the graph), the data did not support a significant difference between the two experimental groups,  $t(29) = -.27, p = .784$  and  $t(29) = .86, p = .395$ . The difference between the averages of these groups was of 0.69 and 5.57, respectively. These results are available in Table 4.

Although no hypotheses were formulated in this respect, the data gathered were also

analyzed in regards to the differences in eye movements between those who answered correctly and those who answered incorrectly, for each of the two experimental groups. We considered the decision (correct/incorrect) as an independent variable, and we reanalyzed the dependent variables from the perspective of outliers and distribution normality.

Table 5. *Mann-Whitney U Test*

	Design Type			
	Integrated		Segmented	
	<i>U</i>	Sig.	<i>U</i>	Sig.
Length of graph fixations	29	.864	16	.221
Length of text fixations	27	1.000	28	1.000
Number of graph fixations	29	.864	16	.221
Number of text fixations	21.5	.529	31	.743
Number of integrations	34.5	.388	31	.743

Following this procedure, we used the Mann-Whitney U test. The data did not display a significant difference between those who answered correctly and those who answered incorrectly, for any of the five variables in either of the two design types (Table 5).

## Discussion

According to the chi-square test, this experiment did not reveal that the structure of the report had a significant effect on the accuracy of the hiring decision. The only hypothesis supported by the data was that an integrated design of the material facilitates integration transitions between graphics and text. The data also did not support significant differences in eye movements between the participants who selected the right candidate and the participants who selected the wrong candidate.

## General Discussion

Focusing on the effectiveness of psychological assessment reports, this paper has reported on two experiments that have tested the spatial contiguity principle, applied to the construction of assessment reports. As previously stated, there is no standard in the

construction of assessment reports with big consequences on the selection process the candidates have been through. Therefore, we have drawn upon the cognitive fit theory and the cognitive load theory, both of them being tested so far only in educational settings and learning tasks. We extended these theories in the field of decision-making, mainly in selection settings, in order to find scientific evidence on the effective ways of constructing an assessment report. Another element of novelty of this research is the use of eye-tracking methodology outside the marketing area, and within an industrial-organizational psychology research.

Contrary to the general findings of the scientific literature (Craig, Twyford, Irigoyen & Zipp, 2015; Mayer & Fiorella, 2014), the data gathered in the first experiment could not support the superiority of the integrated material over the spatially distant one: the two experimental groups displayed very similar results. Specifically, of the participants who have received a report with an integrated design, about 58% selected the correct candidate, and among the participants who received a report with a spatially distant design, 57% provided the correct answer. In the second experiment we detected more

accurate responses within the group that received an integrated report compared to the other group, but the difference is statistically insignificant. Taking into account the results of the first experiment and the magnitude of the effect size available in the scientific literature on integrated materials, the only explanation for the results of Experiment 2 is the very small sample size (i.e., the study was underpowered), which did not allow for capturing a real picture of the data. The data collected with the eye-tracker does not show much consistency in the sense of an underlying explanatory mechanisms: the only hypothesis supported by the data was that an integrated form of the report facilitates the integration transitions between graph and text. In other words, when the text is in close proximity to the corresponding graphical presentations, people tend to better integrate the information. This is consistent with previous research (Johnson & Mayer 2012). Unfortunately, the integration of information was not reflected in the accuracy of the decision; although the participants of the first experimental group achieved more integration, this did not affect performance in the actual task. Although previous studies suggest that people who handle an integrated design pay more attention to graphic representations (Schmidt-Weigand et al., 2010), the results of our studies did not detect a significant difference between the two experimental groups in terms of the number or duration of fixations on the graph. Moreover, following in-depth analyses of differences in the pattern of eye movement between those who gave the correct answer and those who did not, no significant effect for any of the studied variables was obtained.

The results of this paper could be explained from several perspectives. First of all, according to the post hoc analysis, both sample sizes were too small to detect a significant difference between groups. Secondly, the lack of profound understanding of the job description could lead to incorrect decisions. The actual understanding participants had regarding the job description was not controlled for in any way.

Another potential explanation of the inconclusiveness of the results is that the

spatial contiguity principle, which was the underlying theoretical framework of this paper, was exclusively tested in learning tasks. Although the magnitude of the effect reported by such studies is high,  $d = 0.72$  (Ginns, 2006), this principle may not be as effective in decision-making processes. Moreover, previous research has concluded that the spatial contiguity principle is better observed in complex tasks where people have no prior knowledge of the material presented, or when the understanding of the graphical representations used does not require associated verbal explanations (Mayer & Fiorella, 2014). In this context, it is unclear what the complexity of the assessment reports is and how much prior experience the participants would need in order to be able to solve the task optimally. Regarding the results of Experiment 2, the duration and number of fixations on the graph did not differ between the two groups; one possible explanation could be that each type of report was presented on a single page, and the principle of space contiguity could not be captured in such a presentation, because participants in both Group 1 and Group 2 similarly analyzed both the text and the graph.

We point to a number of limitations of this paper. Firstly, we note that the sample sizes are small (i.e., both studies were underpowered) and the samples are mainly comprised of participants with no prior experience in the field of assessment. Secondly, we point to the fact that the design did not assess to what extent participants have correctly understood the information provided in the job description. Future studies should first address these two limitations. Thirdly, in order to investigate explanatory mechanisms of the relationship between the information presented in a report the subsequent hiring decision, researchers should aim to use a portable and not a static eye-tracker. The spatial contiguity principle could be more easily detected in the context in which the report would be presented in its entirety on paper, with a significantly larger distance between the graph and the text.

In conclusion, although this paper could not capture any significant effects of how information is presented in an assessment

report, the fact that nearly 50% of respondents have provided a wrong answer is a solid argument for this line of research, speaking for the importance of continued research in this area.

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