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The importance of colour on the communication of financial data in management

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Abstract

Purpose – The purpose of this paper is to explore the importance of colour on the communication of financial data in management and to encourage future discussion on related topic.
Design/methodology/approach – Hypothesis was designed building on relevant literatures. Quantitative discrete data were collected through a mini-test activity in a lecture from students. The results were reviewed and evaluated by relevant statistical tool.
Findings – The authors found consistent statistical significance results in the mini-test. The findings support that users prefer to choose the financial data presented in cool colours in business management context.
Research limitations/implications – Gaining the understanding of colour's influence on decision making and behaviour is subjected to complexity. There are many other contextual factors should be taken into consideration in practice. Although the design of the mini-test in this study is relatively simple, it still provides clues for the issue. With the discussions and findings of this paper, the authors shed some light on the direction of potential uses of colour on the communication of financial data in management context. The findings could also be used by management educators to facilitate related discussions among students regarding the complexity of business communication and the importance of perception in decision making. For example, decision making could be affected by various factors (such as colour) outside verbal and text.
Originality/value – Managers often need to use financial data in communication for various purposes in work place. The authors believe this is the first time that a study like this had been conducted to specifically review and discuss the importance of colour on the communication of financial data in management. Hopefully, the work reported in this paper could be viewed as reference for management educators, researchers and managers in future research or practical applications on related topics.

Keywords Perception, Communication, Management, Decision making, Colour, Financial data

Paper type Research paper

1. Introduction

Managers often need to use financial data in communication for various purposes in work place. For examples, providing sales target to the team, explaining bonus scheme to incentive employees or discussing budget figures with subordinates, etc. Therefore, effective

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communication of financial data is the key for managers to get work done with and through people.

There are many ways for managers to achieve better communication, such as using story telling approach to boost engagement and well-being (Wall and Rossetti, 2013), changing the tone of words in financial reports to affect investor decisions (e.g. Huang *et al.*, 2013).

This paper aims to explore the importance of colour on the communication of financial data in management and to encourage future discussions. In fact, previous studies have discussed the correlations between colours and user's perceptions on different things. For instance, in the study of Bayarri *et al.* (2001), researchers discovered the influence of colour on perception of sweetness and fruit flavour of fruit drinks. Therefore, it would be interesting to see if managers can use colour to make finance data "sweeter" in work place. Moreover, this paper could also be used by management educators to facilitate related discussions among students regarding the complexity of business communication and the importance of perception in decision making.

The rest of the paper is organized as follows. In Section 2, we reflect the role of financial data in management by reviewing and summarizing related literatures. Building on the literatures, Section 3 discusses the relationship between the use of colour and user preference on choosing financial data. Moreover, this section summarizes the development of proposed hypothesis and introduces a mini-test that was used for testing the hypothesis. The results of mini-test are then reported in Section 4. Section 5 provides discussions and recommendations for future works.

2. The role of financial data in management

This section reflects the role of financial data in management by reviewing and summarizing related literatures. The reflection serves as a foundation for this study.

There are many ways to define management. When "what is management" was typed into Google (as at 30 May 2019 at 11.43 a.m., UK time), it returned 6,820,000,000 results.

In this work, we define "management" as:

> A set of human activities happens in work place led by economic goals.

This definition is developed based on following literatures. First, as per Garrison *et al.* (2017), management works involve three major human activities (i.e. planning, direction and motivating and controlling). Second, "management happens in work place" because the term "management" often associate with work and employment (Hendry, 2013). Third, "management" should be led by economic goals', this is because, as per Drucker (2011), "Management must always, in every decision and action, put economic performance first". In addition, it is also worth noting that economic goals are often presented in the form of financial data in work place, such as target sales, gross margin, bonus, costs, return on investment, payback period, and many others, etc.

Human activities can also be understood as product of human behaviour. On this, there are two classical theories that can be used to explain how data affect human behaviour. The first one is Simon's (1959) model of decision making, it explains human's decision making involves three stages: intelligence, which deals with the problem identification and the data collection on the problem; design, which deals with the generation of alternative solutions to the problem at hand; and choice, which is selecting the "best" solution from amongst the alternative solutions using some criterion.

Rational choice theory (Downs, 1957) can be used to explain how users select the "best solution" in the third stage of the Simon's model of decision. Rational choice theory is a well-established framework for understanding (and modelling) human behaviour. The basic assumptions of the rational choice theory are humans are goal oriented and humans make decision based on rational calculations.

Figure 1 summarizes the above discussions. Given economic goals are often presented in the form of financial data in work place; data would affects human behaviour; human behaviour produces human activities; and (iv) human activities are a key component in management, it forms a link between financial data and management.

In practical term, the link between financial data and management is communication. This is because users' decision would be affected by what data they received during communication and then their behaviour (or actions) will be changed accordingly as well. For example, very often a sales manager would use sales commission to motivate salespeople to work towards predefined targets, but it also depends on how the salespeople understand the sales commission package and the understanding would affect how much effort they are willing to put in.

However, how to communicate financial data effectively has long been a practical challenge, in particular we are now living in the age of the big data. In brief, a key challenge of financial data communication is that we have too much data. An interesting figure was found as at 30 May 2019 from www.physics.org/; it suggests that "It would take around three million years to download all the information currently on the internet, assuming a download speed of 44 megabits per second". This is a foreseeable trend that the volume of data will keep increasing because of the development of Internet of Things and Financial Technology (Leong and Sung, 2018).

An impact of increasing among of data around us is the decrease of our attention span. Music industry shows an example on how our attention span is decreasing. As per Gauvin (2017), the average time that passed before audience would hear the vocals on any radio song was 23 s, today the average intro is just 5 s long.

Poor attention would negatively affect decision-making quality and then unintended behaviour. In order to improve user's attention span during communicating financial data in management, data visualization is a possible way, this is because human brain processes image 60,000 times faster than text (Vogel *et al.*, 1986). Among other sub-topics under data visualization field, the focus of this study is regarding the use of colour in financial data communication.

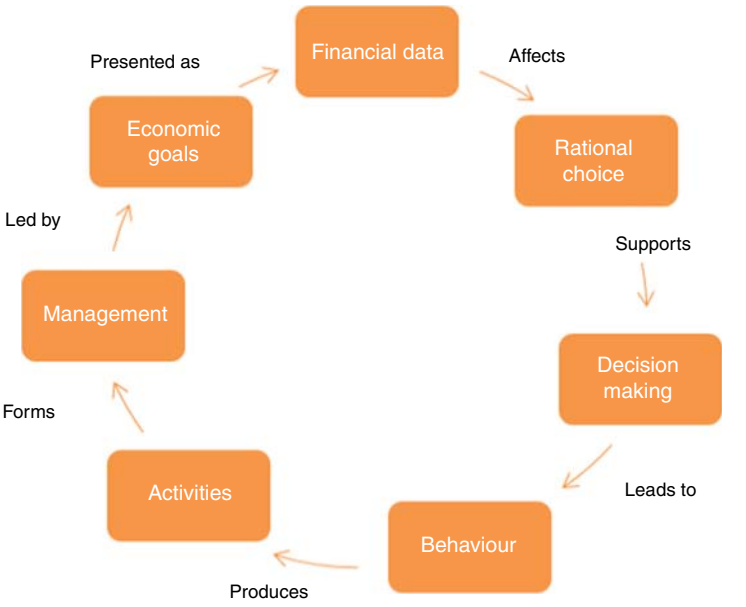


Figure 1.
The link between financial data and management

3. Use of colour and user preference on choosing financial data

Colour plays a key role in user's decision-making process. Scientist and researchers have long studied the relationship between colour and human behaviour. As far back as 1810, Goethe published his *Theory of Colors* that he linked colour categories to emotional responds (Schindler and Goethe, 1970).

In past decades, some related studies are as follows. Birren (2013) provided a systematic discussion on linking how humans perceive colours to how it makes them react. Neurobiologists (Livingstone and Hubel, 1988; Livingstone and Hubel, 2008) explained how human visual system deal with different wavelengths of light and how colour affect perception. The works of Hemphill (1996) and Mahnke (1996) suggested the strong correlations between colours with human emotions and feelings. Aslam (2006) found that colour induces moods and emotions, influences consumers' perceptions and behaviour. Elliot *et al.* (2009) indicated that colour can be used to subconsciously influence people's behaviours and motivations. Valdez and Mehrabian (1994) concluded that people experienced the greatest pleasure from seeing bright, saturated colours. Singh (2006) suggested that "people make up their minds within 90 s of their initial interactions with either people or products, with about 62–90 per cent of the assessment is based on colours alone". Kress and Leeuwen (2002) found that adding colour to documents can increase the reader's attention by more than 80 per cent. Also, if the amount of money on an invoice is presented in a colour as opposed to a mono-colour, the amount is 30 per cent more likely to be paid on time. In addition, by studying a survey of 100 Hong Kong annual reports, Courtis (2004) found there were some colours has positive effects on perception formation and investment allocations. So and Smith (2002) reported the results of a laboratory experiment and found colour graphics improve decision making.

There are many different colours in the world, one of the widely adopted approaches is to classify the colours into cool colours or warm colours according to the hue angles. In brief, red, yellow and orange hue angles are considered to be warm colours, on the other hand, blue, purple and green hue angles are referred to as cool colours (Luo *et al.*, 2004). Previous study (Lee *et al.*, 2011) suggested that cool colours are perceived to encourage positive emotions, whereas warm colours tend to inflict and associate to negative emotions.

We, therefore, hypothesize:

H1. Users would prefer to choose the financial data presented in cool colour than warm colour in business management context.

In order to evaluate the proposed *H1*, a mini-test was designed and arranged as follows.

As per the Appendix, the mini-test contains only three questions and each question is related to a business management situation. For each pair of the options (i.e. answers) in the questions, there is one option presented in cool colour, while another option presented in warm colour.

We used *Kahoot* (https://kahoot.com/) to conduct the mini-test in a lecture for Level 4 (first year undergraduate) business students and majority of them are not major in accounting and finance. Students were asked to answer the questions independently using their own mobile devices.

The "Kahoot" is a game-based learning platform supporting multiple-choice quizzes. The gameplay of this mini-test is simple; all participants connected using a generated game PIN shown on the common screen, and used their own device to answer each questions simultaneously. The corresponding statistics of responses were recorded manually immediately after completion of each question by the researcher.

Although the design of the mini-test is relatively simple, it still provides clues for the issue. The results of the mini-test are reported as follows.

4. The results of the mini-test

Corresponding statistics of responses for the questions are shown below.

In total, 44 students were in the lecture, but not all students participated the mini-test. Moreover, as per Figure 2, the total number of responses are different in the three questions: it indicates that for those students who participated in the mini-test, some of them answered all the three questions, while some of them answered one or two questions only. This was an anonymous mini-test and we do not know who answered which questions.

Overall, as per Figure 2, the results of the mini-test show that participants preferred financial data presented in comparatively cool colours rather than financial data presented in comparatively warm colours. Moreover, these patterns are consistently found across the three questions.

Recall that in the *H1*, we proposed "Users would prefer to choose the financial data presented in cool colour than presented in warm colour in management context". We then suggested the null hypothesis (i.e. the expectation) as the opposite situation, that is:

H_0. Users would have no preference on choosing the financial data presented in cool colour or warm colour in business management context.

In this study, given discrete data (i.e. frequencies of option A or B in each question) were collected and our goal was to determine whether or not there was a significant difference between the observed frequencies and the expected frequencies for each question. Therefore, χ^2 test instead of *t*-test or alike was selected and applied as the statistical test in this study. The observed frequencies and expected frequencies were obtained as follows:

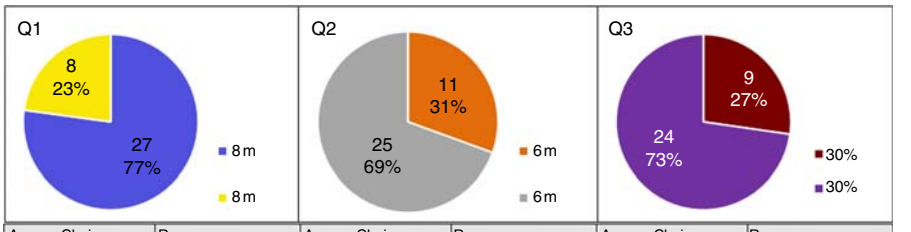
- the observed frequencies were obtained from the mini-test; and
- the expected frequency of the answer at each question was based on H_0, that is, there are 50:50 chance that a participant would choose cool colour or warm colour (i.e. no preference).

According to the χ^2 test results, as presented in Table I, we found statistical significance results (Q1 ($\chi^2 = 10.3143$, $p < 0.01$), Q2 ($\chi^2 = 5.4444$, $p < 0.05$) and Q3 ($\chi^2 = 6.8182$, $p < 0.01$), df = 1). Therefore, H_0 for Q1–Q3 should be rejected. These results support that users prefer to choose the financial data presented in cool colour in business management context.

5. Discussion and recommendations for future works

According to the mini-test results, users preferred to choose an item with financial data presented in comparatively cool colour and the results of the pattern are consistent across the three questions.

With the findings from the mini-test, we shed some light on the direction of potential uses of colour on the communication of financial data in management. For examples, if a manager wants to motivate his/her team to work harder in next week by introducing a



Answer Choices	Responses		Answer Choices	Responses		Answer Choices	Responses	
	in %	Count		in %	Count		in %	Count
8 m	77	27	6 m	31	11	30	27	9
8 m	23	8	6 m	69	25	30	73	24
Total		35	Total		36	Total		33

Figure 2.
Summary of corresponding statistics of responses in Q1–Q3

Categories	Observed O_i	Expected E_i	χ^2 component $(O_i-E_i)^2/E_i$
Q1			
8m (blue – cool)	27	17.5	5.1571
8m (yellow –warm)	8	17.5	5.1571
Total	35	35	10.3143
p-value		0.00132	
Q2			
6m (orange – warm)	11	18	2.7222
6m (grey – neutral)	25	18	2.7222
Total	36	36	5.4444
p-value		0.019631	
Q3			
30% (dark red – warm)	9	16.5	3.4091
30% (purple – less cool)	24	16.5	3.4091
Total	33	33	6.8182
p-value		0.009023	

Table I. χ^2 test results of Q1–Q3

bonus scheme, the manager may consider to use cool colour to present the bonus figure in order to make a good first impression. Other than this, a finance controller may use warm colours to present cost budget to department heads in order to discourage using money.

Moreover, this paper could also be used by management educators in various ways. For examples, the findings could inform business communication education, not limited to finance data presentation, but also on other business-related topics. The findings could also be used in class discussion about potential relationships between psychological factors and perception during management communications. Moreover, lecturers could also consider altering the mini-test questions in this paper in other business contexts to facilitate students to reflect how different factors in communications could affect business decision making.

However, it is worthy to note that gaining the understanding of the colour's influence on decision making and behaviour is subjected to complexity, as individuals form personal associations and preferences to colour based on their own culture and personalities (Grossman and Wisenblit, 1999). Taken red colour as an example, such association between red and risk may be seen as a view from a western culture, whereas, the colour red holds an opposing meaning within the Chinese culture; red is considered as a connotation for positive feelings; joyous, happiness and good luck (He, 2009). Another example is the blue colour, blue encourages feelings of relaxed, calm and comfort. Kaya and Epps (2004) found that the mood created by the colour blue is explained and induced by the strong association with the calming elements of nature such as water, the ocean and the sky.

Furthermore, previous studies also suggested that there is a difference in the preference and perceptions of colours between genders. Khouw (2002) suggested that males seemed more tolerant of grey, white or black in comparison to females, and also, women reacted more frequently to the combination of red and blue colours. It is also suggested that a person's age can impact on how colour is perceived. On the other hand, young age individuals are attracted by warm and strong colours, and as the individual's age increases, the attractiveness of warm, strong colours decreases. Instead, subdued colours become more attractive (De Bortoli and Maroto, 2001). Moreover, in many different languages, in a non-literal way, the word red refers to dangerous situations to be avoided. In the finance and investment domain, such phrases include "in the red" to describe financial losses and "red flags" as a warning sign (Bazley *et al.*, 2016). Therefore, in financial communication, red may lead to pessimistic perceptions, which in turn, low risk taking behaviours would be seen

as a reflection. This is confirmed by Gnambs *et al.* (2015), whose study identified that the application of the colour red led to conservative choices and low risk decisions, whereas the application of grey and blue colours encouraged risk taking behaviours and decisions.

In sum, there are many other contextual factors should be taken into consideration in practice when deciding what colour should be used to present financial data in management communication. Nevertheless, we believe this is the first time that a study like this had been conducted to specifically review and discuss the importance of colour on the communication of financial data in management. Hopefully, the work reported in this paper could be viewed as reference for management educators, researchers and managers in future research or practical applications on related topic.

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Appendix. The three question in the mini-test

Q1)
You are given the net operating results of two division, A and B. The profit and loss are indicated by two different colours separately. However, you don't know which colour indicate profit and which colour indicate loss. Assume you need to select the division with better performance, you will select which one of the following divisions?

- o 8 million
- o 8 million

Q2)
You are given the net assets balances of two departments, A and B. The positive balance and negative balance are indicated by two different colours separately. However, you don't know which colour indicate positive balance and which colour indicate negative balance. Assume you need to select the department with better performance, you will select which one of the following departments?

- o 6 million
- o 6 million

Q3)
You are given the sales change percentages of two products, A and B. The increase and decrease are indicated by two different colours separately. However, you don't know which colour indicate increase and which colour indicate decrease. Assume you need to select the product with better performance, you will select which one of the following products?

- o 30%
- o 30%

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