

Visual Format for Effective Risk Communication on a Dilemma Decision Making

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Abstract: The presentation and perception of risk are of great importance in the field of screening. Presenting the risks of fatal abnormality to pregnant women is important in counseling prior to offering prenatal screening tests. These risks must be balanced against the risks of harm caused by diagnostic investigations that often means that patients and professionals are faced with difficult judgments. Thus, the purpose of this study is to consider how these visual presentation tools can be developed to communicate risk more effectively, especially in the dilemma decision making process. Related studies have revealed that visual presentation such as graphics; illustration and pictures affect perceived risk, attitude and behavior. A questionnaire method was applied to this research to evaluate 9 different formats of dilemma decision making tools. By using t-test and one-way ANOVA, this study was trying to find out if risk perception and different ages affect the choices of the screening tests in a dilemma decision making process. The findings were: (1) the average risk perception of the 9 communication tools were between medium to high , and women's recognition varied significantly; (2) there was no significant difference between the choices of high-risk and low-risk perception; (3) there was significant difference ($p < 0.05$) between two age groups in ratio data format , abstract image format, discrete concrete image format, and sequential concrete image format ($P < 0.05$), and very significant difference in text format, histogram format, and proportion data format ($p < 0.01$).

Keywords: *dilemma decision making, visual presentation format, Patients Decision Aids*

1. Introduction

In recent years, people's cognitions on medical treatment have changed. The one-way and dominated "doctor-centered" relation changes to "patient-centered" relation. This change does not imply the degradation of the doctors' function in medical treatment; it means to treat doctors and the patients equally (Henbest and Stewart, 1989). In fact, the ideal medical treatment should combine the "doctor-centered" and "patient-centered" methods, thus exchanging information freely and providing the best therapies. An active role of patients in the decision-making process is becoming more and more important, and discussing the risks and benefits of the treatment is therefore an essential part of modern health care (Timmermans, Molewijk, Stiggelbout & Kievit, 2004). Risk is not an absolute but is an estimate in time and may change if testing is repeated or extended. When patients are confronted with difficult medical decisions, health care providers and decision aids both play a critical role in informing patients about the risks and benefits of treatment (Fagerlin, Wang and Ubel, 2005). Complex information must be combined to help patient understand the options and make a decision whether to undergo further testing and how to act on the results, and it often happened in time limited circumstances (Hinshaw et al., 2006).

Presenting the risks of fatal abnormality to pregnant women is important in counseling prior to offering prenatal screening tests. These risks must be balanced against the risks of harm caused by diagnostic investigations that often means that patients and professionals are faced with difficult judgments. In Taiwan, older pregnant women were encouraged to adapt Amniocentesis testing to see if their babies were healthy, but Amniocentesis testing may cause abortion in 0.5% of cases. In order to understand the influences of different risk presentation format on interviewee's recognition and choices of decision making, this research aimed to survey pregnant women's recognition of presentation tools on a dilemma decision making.

2. Visual tools for risk communication

2.1 Patients Decision Aids

A good communication would have a positive influence on the patients, and would contribute to the medical decision making, it's also the main purpose of Patients Decision Aids. Decision aids should include evidence-based information about all viable treatment options, a balanced value-neutral presentation of the advantages and disadvantages of every option, and information related to the patient perspective to help patients understand their preferences and values about their treatment (Holmes- Rovner et al, 2007). There were three parts in decision aids conceptual frameworks: (1) prescriptive expected utility frameworks: discussion with patients about their preferred option; (2) descriptive frameworks: use the decision tree to describe each option, its outcomes, and related probabilities; (3) transactional frameworks: describe patient and professional transactional roles in a clinical encounter. As we can see from these frameworks, the first stage is trying to understand patients' thoughts, explain and help patients understand all advantages and disadvantages of options is the key point in the second stage, and then start the conversation and discussion about the treatment

between doctors and patients. When people are trying to understand and make decisions about risk, they tend to see various aspects of the risk in visual formats (Lundgren and McMakin, 1998).

It has been found that the benefits versus the harms are often uncertain in the medical decision making, and which was also called as “gray-zone” decision. When patients face this “gray-zone” situation, some supplementary tools were developed to assist patients understanding the treatment options, and then to help them to make appropriate decisions. The way information is presented to a patient and any advice or guidance given with it may influence their decisions.

2.2 Visual tools for risk communication on a dilemma decision making process

In order to help patients effectively participant in the decision making process, they need information in a format that they preferred to help them making decisions. There are many studies focused on the interventions of risk communication to optimize decision-making, only a few studies are concerned with the formats of information presentation for effective risk communication. However, data can be described using variety different graphical formats as well. Visual presentation such as graphics, illustration and pictures can help patients understand risks easily and affect perceived risk, and the decision-making process and behaviour. Current recommendations for communicating information about uncertain future events emphasize the importance of presenting data in a balanced manner that avoids framing effects, provides baseline risk information, and uses graphic risk displays whenever possible (James & Stephen, 2008). Research about the communication of risks has shown that the context and format in which risk are presented affect people’s perception and their subsequent decision (Timmermans, 2005). It is now understood and accepted that to be effective it is not sufficient that graphic and information design be accurate and visually attractive, it must also reach the emotions of the viewer. The graphical displays were used to affect risk perceptions and other outcomes focusing on risk ladders, stick or facial displays, line graphs, dots or marbles, pie charts and histograms (Lipkus, and Hollands, 1999).

Table format is the most widely used risk communication method. It can be easily memorized or understood, and can reduce the cultural and language gaps. Relevant contents can be connected by colours, sizes, shapes and alignments to make them comparable (Lundgren & McMakin, 1994). Figure 1 adopted the concept of decision tree, this flow diagram can make viewer easily to understand the results of two different treatment options.

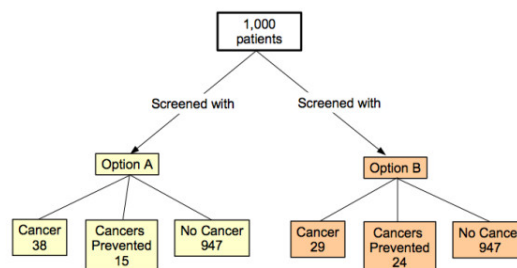


Figure.1 The flow diagram

Figure 2, the left hand panel is a standard bar chart showing the entire dataset; the right bar chart magnifies the differences between the two options so the magnitude of the differences can be seen more clearly. This bar chart is designed to show the differences between 2 types of data, and is easy for viewers to compare the data, but not the overall relationship.

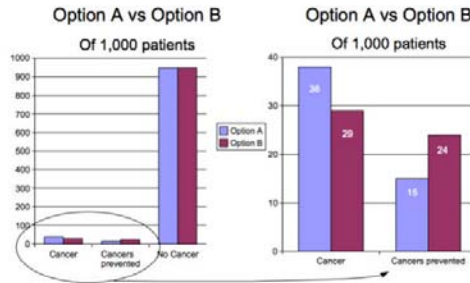


Figure.2 The augmented bar chart

In general, image format may attract more attention, and be easily understandable (Sevilla, 2002). However, Timmermans et al. (2004) found that fewer patients would choose surgery when image format risk communication is adopted, as compared to other presenting methods. This result shows that image format presentation is not better than other presentation. As mentioned in previous studies, compare to the abstract icons, females prefer concrete ones because they think it is easier to understand.

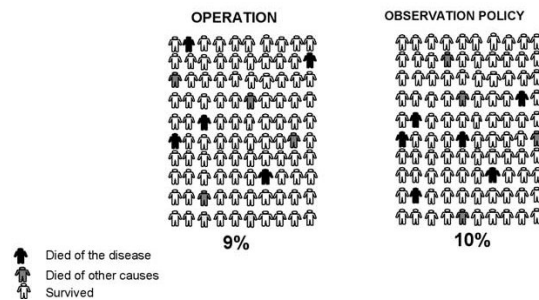


Figure.3 The image format with concrete icons

Another format arrays with sequential arrangement, proportions are easy to judge in this icon array because the part-to-whole information is available visually. Because the square icons are touching each other, so it can be easily arranged as a block and, it is possible that they are visually processed as areas rather than as discrete units (Fagerlin A, Wang C, Ubel PA, 2005).



Figure.4 Successfully and not successfully cured of angina

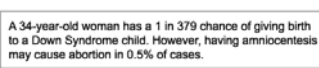
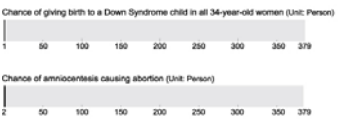
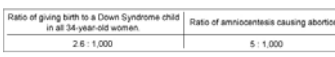
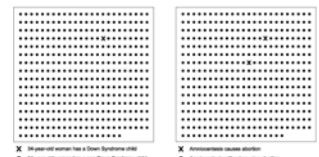
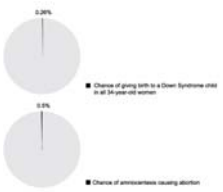
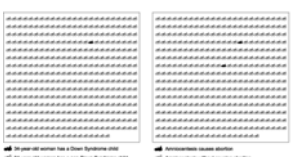
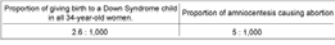
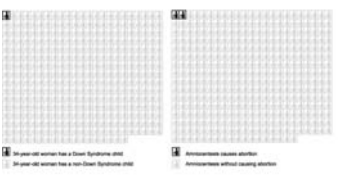
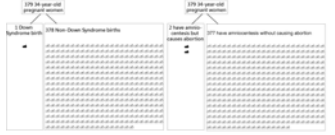
In the medical domain, “patient decision aids” are tools designed to communicate the best available evidence on treatment or screening options to patients (Holmes-Rovner et al., 2007). Research about the communication of risks has shown that the context and format in which risk are presented affect people’s perception and their subsequent decision (Timmermans, 2005). It is important to transmit the information more effectively and efficiently, and information designers seek to combine skills in these fields to make complex information easier to understand.

3. Research Methods

3.1 Risk communication tools

9 different formats of dilemma situation were developed in this research (see table 1), and all of them were adopted the same information of the risk for pregnant women to conceive babies with Down syndrome, and the chance of amniocentesis causing abortion. We put these two comparative data together to see if the dilemma situation will affect their choices, including text format, ratio data format, proportion data format, histogram format, pie chart format, abstract image format, discrete concrete image format (the icons are arranged as a block and touching each other), sequential concrete image format (the icons are not touching each other), and a composite format.

Table 1. 9 different formats of risk communication tools

		
<p>text format</p> 	<p>histogram format</p> 	<p>ratio data format</p> 
<p>abstract image format</p> 	<p>pie chart format</p> 	<p>discrete concrete image format</p> 
<p>proportion data format</p>	<p>sequential concrete image format</p>	<p>composite format</p>

3.2 Questionnaire survey

A questionnaire was applied to this research to measure the differences and the effects of various presentation formats on cognition, and if risk perception and different ages will affect the choices of

the screening tests in the dilemma decision making process. Since the tool of this questionnaire presented the same risk data, it adopted 9 arrangements to prevent learning effects. A total of 89 questionnaires were distributed to female interviewees, and valid 80 samples were returned.

4 Results and Discussions

4.1 Analysis of the choices of the 9 risk communication tools

This study found that the average values of the 9 tools are 3-4 (medium to high). Chi-square test showed that $P < .05$, it was suggested that women's recognition of communications varied significantly among the 5 choices of "very high", "high", "medium", "low", and "very low". The choice of "high" was most selected among the 9 communication tools. The analysis of Chi-Square test frequencies showed that: (1) in text format, "high" was the most selected; (2) in ratio data format, "high" was the most selected, followed by "medium", as selected by 23 subjects; (3) in proportion data format, "high" was the most selected, followed by "medium", as selected by 22 subjects; 4) in histogram format, "high" was the most selected, followed by "medium", as selected by 21 subjects; (5) in pie charts, "high" was the most selected, followed by "low", as selected by 21 subjects, and "medium", as selected by 18 subjects; (6) in abstract image format, "high" was the most selected, followed by "medium", as selected by 25 subjects; (7) in discontinuous concrete image format, "high" was the most selected, followed by "medium", as selected by 22 subjects; (8) in continuous concrete image format, "high" was the most selected, followed by "medium", as selected by 27 subjects; (9) in multiple selections, "high" was the most selected, followed by "medium", as selected by 17 subjects.

Table 2 Statistics of women's selection among the 9 risk communication tools

	Mean	SD	low risk			high risk		Total
			1 very low	2 low	3 medium	4 high	5 very high	
text format	3.69	1.051	4	7	15	38	16	80
ratio data format	3.35	1.080	5	12	23	30	10	80
proportion data format	3.52	1.073	4	9	22	30	14	79
histogram format	3.32	1.167	7	12	21	28	12	80
pie chart format	3.04	1.115	7	21	18	28	5	79
abstract image format	3.30	1.048	5	12	25	30	8	80
discontinuous concrete image format	3.23	1.085	5	16	22	28	8	79
continuous concrete image format	3.32	.955	3	12	27	31	6	79
composite format	3.34	1.102	6	13	17	36	8	80

According to literature review and research findings, different presentation methods would affect

patients' recognition of risk, making patients over-evaluate or under-evaluate the possibility of risks. A text format may make patients over-evaluate the risk, while pie charts may lead to under-evaluations. We further defined the women's risk perception into "high risk perception" group and "low risk perception" group by the results of Likert 5-point scale.

4.2 The differences between risk perception and the choices of the screening tests in the dilemma decision making process

In the first part of the questionnaire, a Likert 5-point scale was used to measure risk perceptions of the 9 different risk communication tools, and we further defined it as "high risk perception" group and "low risk perception" group; in the second part, 9 different formats of dilemma decision making developed based on the first part of the questionnaire, and we further ask the interviewees if they will accept amniocentesis or not? By the test of homogeneity of proportions, we found that there was no significant difference between the risk perception and the dilemma decision making. It means "high risk" and "low-risk" group both tend to accept amniocentesis (the range of acceptance is from 65.6% to 72.1%). The text format is most selected to accept amniocentesis testing (72.1%), followed by discrete concrete image format (71.4%), and composite format is least selected (65.6%).

Table 3 Crosstabs of risk perceptions and amniocentesis choices

	perception	amniocentesis		Total	Sig.
		accept	deny		
text format	high risk	60.3%	25.0%	85.3%	.545
	low risk	11.8%	2.9%	14.7%	
	total	72.1%	27.9%	100%	
histogram format	high risk	53.1%	17.2%	70.3%	.071
	low risk	15.6%	14.1%	29.7%	
	total	68.7%	31.3%	100%	
ratio data format	high risk	51.6%	21.0%	72.6%	.626
	low risk	17.7%	9.7%	27.4%	
	total	69.3%	30.7%	100%	
abstract image format	high risk	52.5%	18.0%	70.5%	.147
	low risk	16.4%	13.1%	29.5%	
	total	68.9%	31.1%	100%	
proportion data format	high risk	51.6%	27.4%	79.0%	.248
	low risk	16.1%	4.9%	21.0%	
	total	67.7%	32.3%	100%	
pie chart format	high risk	44.8%	13.4%	58.2%	.085
	low risk	23.9%	17.9%	41.8%	
	total	68.7%	31.3%	100%	
discrete concrete image format	high risk	49.2%	17.5%	66.7%	.554
	low risk	22.2%	11.1%	33.3%	
	total	71.4%	28.6%	100%	
sequential concrete image format	high risk	51.9%	22.2%	74.1%	.692
	low risk	16.7%	9.2%	25.9%	
	total	68.6%	31.4%	100%	
composite format	high risk	50.7%	22.4%	73.1%	.291
	low risk	14.9%	12.0%	26.9%	
	total	65.6%	34.4%	100%	

Since Down syndrome and amniocentesis testing has been advocated for many years in Taiwan, so the public has a basic understanding of it. That may be the reason most of our interviewees perceive the risk as higher, and tend to accept the amniocentesis testing. Besides that, as we can found from table 2, most interviewees perceive the risk of text format is higher than others (85.3%), followed by

proportion data format (79.0%); and pie chart format is lowest in these 9 different formats(58.2%).

4.3 The differences between ages and the choices of the screening tests in the dilemma decision making process

According to the related literature, the probability of chromosome disease will increase with the pregnant woman's age. Bureau of Health Promotion, Department of Health, R.O.C. (Taiwan) indicated that the probability of chromosome disorder in all screening test subsidized women older than 34(49.3%) was twice than the women younger than 34(24.66%) (Bureau of Health Promotion, Department of Health, Taiwan, 2008). In Taiwan, we often use the data for 34-year-olds as the baseline for the group with higher risk of having babies with Down Syndrome in official documents. (Bureau of Health Promotion, Department of Health, Taiwan, 2008). That is the reason why we divided all the interviewees into 2 groups by the age 34(age \leq 33, age \geq 34). According to table 4, there was a significant difference (p<0.05) between these two groups in ratio data format, abstract image format, discrete concrete image format, sequential concrete image format (P<0.05); and very significant difference in text format, histogram format, proportion data format (p<0.01) in adopting amniocentesis testing. The range of accepting amniocentesis testing in group ages \leq 33 is from 52.0% to 60.0% , discrete concrete image format (60.0%) is most selected, followed by text format (58.0%), pie chart format (58.0%) ,and proportion data format (52.0%) is least selected one. In group age \geq 34, the range is from 74.3% to 85.7%, text format (85.7%) is most selected, followed by histogram format (82.9%) , and composite format (74.3%) is least selected one.

Table 4. Crosstabs of ages and amniocentesis choices

	ages	Amniocentesis		Sig.
		accept	Deny	
text format**	\leq 33	58.0%	42.0%	.006**
	\geq 34	85.7%	14.3%	
histogram format**	\leq 33	54.0%	46.0%	.006**
	\geq 34	82.9%	17.1%	
ratio data format*	\leq 33	54.0%	46.0%	.047*
	\geq 34	75.0%	25.0%	
abstract image format*	\leq 33	54.0%	46.0%	.023*
	\geq 34	77.8%	22.2%	
proportion data format**	\leq 33	52.0%	48.0%	.008**
	\geq 34	80.0%	20.0%	
pie chart format	\leq 33	58.0%	42.0%	.056
	\geq 34	77.8%	22.2%	
discrete concrete image format*	\leq 33	60.0%	40.0%	.043*
	\geq 34	80.6%	19.4%	
sequential concrete image format*	\leq 33	54.0%	46.0%	.017*
	\geq 34	79.4%	20.6%	
composite format	\leq 33	55.1%	44.9%	.072
	\geq 34	74.3%	25.7%	

5 Conclusion

Medical decision-making is a complex and difficult process, especially in a dilemma situation, both

health care providers and decision aids play an important role in informing patients about the harms and benefits of treatment. We are trying to help patients make appropriate decisions by understanding how the different graphical tools affect patients' perceptions in a dilemma decision making process, and transmit the information more effectively and efficiently. Similar to previous related research, we found that different visual tools will affect people's risk perception, but we also found that people perceived risks would not affect their choices of amniocentesis testing, but ages would. The reason why women over and under 34-year-old had significant differences of their choices of amniocentesis testing mostly because of the long-term guidance of Down Syndrome and Amniocentesis testing in the official documents in Taiwan. They often use the data of 34-year-olds as the baseline with higher risk of having babies with Down Syndrome. That's why women ages higher than 34-year-old tend to accept Amniocentesis testing, but women ages lower than 33-year-old wouldn't. We supposed that women ages lower than 33-year-old make their choices mostly by the format itself, so the results of accept and deny the testing were comparatively equal. From this research, we found that any instructions provided to people in any time or any places will all affect their decision making. When trying to communicate the treatment options with patients, we should take their life styles, backgrounds, or even the social phenomena in to consideration to provide balanced value-neutral and most helpful information to them to make appropriate decisions.

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