行政院國家科學委員會專題研究計畫 期末報告

性別差異於空間焦慮與車載式導航系統可用性之影響—比較 2D 與 3D 介面

計 畫 類 別 ：個別型
計 畫 編 號 ：NSC 100-2629-E-006-001-
執 行 期 間 ：100 年 08 月 01 日至 101 年 10 月 31 日
執 行 單 位 ：國立成功大學交通管理科學系（所）

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報 告 附 件 ：出席國際會議研究心得報告及發表論文

公 開 資 訊 ：本計畫涉及專利或其他智慧財產權，1 年後可公開查詢

中 華 民 國 101 年 11 月 27 日

中文摘要： 本計畫結合使用者的性別差異與空間焦慮程度，並考量受測者個別空間能力的差異與空間焦慮來源的難度，探討是否因為性別差異而有所不同，並研究受測者在車用導航系統介面的操作上的績效，了解性別差異於介面可用性的影響。由於每個人適應空間焦慮的能力並非相同，本計畫考量受測者個別能力的差異與空間焦慮來源的難度，使用 Rasch 模式，有效估算出每個焦慮來源造成受測者之困難感受程度，以及每位受測者整體適應空間焦慮的能力，有效的連結空間能力與車用導航系統之可用性。本計畫分析不同性別所具備的空間能力以及探討性別差異是否影響車用導航系統介面使用性。本計畫應用實驗設計，探討性別在操作車用式導航系統上的差異，以客觀量測調查受測者與導航機之間的互動情形。研究結果顯示，性別確實於操作績效上產生顯著差異，男性在操作的績效上優於女性。男性與女性於空間能力上也存在顯著差異，男性有較佳空間能力。過去車用導航系統介面設計的文獻大多為藉由問卷詢問受訪對象或是藉由模擬設計的機台來針對功能介面的排版設計、功能介面應用提出設計的準則，本計畫之實驗設備採用市面上所銷售之車用導航機台，更能貼近現實操作情況，本計畫除了提出功能介面的設計改善外，也納入性別、空間能力、車用導航系統三種解釋變數進行分析，探討不同的使用族群是否在使用操作車用導航系統上會有所不同。此外，以往探討空間能力影響功能選單介面的操作文獻大多集中在電腦選單介面或手機與 PDA 等行動裝置，甚少有研究為探討車用導航系統裝置。隨著車用導航系統銷售量的成長，使其逐漸成為駕駛人行車上重要的輔助工具，本研究課題顯得格外重要。本計畫證實男性與女性確實在操作車用導航系統介面時產生差異，並根據觀察受試者操作情況以及受試者所建議之回饋後提出介面改善的建議，減少使用者操作上的不便，提升使用效率。對於駕駛人而言，過多的設定步驟、點擊介面反應速度過慢以及操作的不便性皆容易讓駕駛人注意力分散，進而影響行車安全，妥善的介面設計有助於駕駛人操作上順利，減少行車上的風險。本計畫介面改善之建議可提供相關業者參考，有效提高整體操作效率，或是提供消費者做為購買決策參考。

中文關鍵詞： 車用導航系統、性別差異、空間焦慮

英文摘要： This study investigated the relationship between gender, spatial anxiety, and CNS operational performance. 600 study participants performed a route-locating task on a car navigation system (CNS) and self-reported their competence to adapt to spatial anxiety using the Spatial Anxiety Scale. The study found gender predicted operational performance: female participants needed more time to perform the designated navigation task than male participants； CNS interface design predicted CNS operational performance； and participants’ competence to adapt to spatial anxiety did not predict CNS operational performance. The study’s results provide manufacturers and marketers with reliable information regarding at whom they should target their CNS products and whether manufacturers should develop interfaces that fit small-display CNSs based on gender. Study findings also play an important role in determining CNS adoption for drivers.

英文關鍵詞： genders； spatial anxiety； CNS operational performance； Rasch model.

附件一

行政院國家科學委員會補助專題研究計畫 ■期末報告

性別差異於空間焦慮與車載式導航系統可用性之影響

比較 2D 與 3D 介面

計畫類別：■個別型計畫 □整合型計畫
計畫編號：NSC 100-2629-E-006 -001
執行期間： 100 年 8 月 01 日至 101 年 10 月 31 日

執行機構及系所：

計畫主持人：林珮珺
共同主持人：
計畫參與人員：王彥傑、郭家玗

本計畫除繳交成果報告外，另含下列出國報告，共 _1__ 份：
□移地研究心得報告
■出席國際學術會議心得報告
□國際合作研究計畫國外研究報告

處理方式：除列管計畫及下列情形者外，得立即公開查詢
■涉及專利或其他智慧財產權，■一年□二年後可公開查詢

中 華 民 國 101 年 11 月 26

行政院國家科學委員會專題研究計畫成果報告

性別差異於空間焦慮與車載式導航系統可用性之影響—比較 2D 與 3D 介面

The Effects of Gender Differences on Spatial Anxiety and Usability of On-Board Car Navigation Systems - 2D vs. 3D Interface

計畫編號：NSC 100-2629-E-006-001

執行期限：100 年 8 月 1 日至 10 年 10 月 31 日

主持人：林珮珺　國立成功大學交通管理學系

一、中文摘要

本計畫結合使用者的性別差異與空間焦慮程度，並考量受測者個別空間能力的差異與空間焦慮來源的難度，探討是否因為性別差異而有所不同，並研究受測者在車用導航系統介面的操作上的績效，了解性別差異於介面可用性的影響。由於每個人適應空間焦慮的能力並非相同，本計畫考量受測者個別能力的差異與空間焦慮來源的難度，使用 Rasch 模式，有效估算出每個焦慮來源造成受測者之困難感受程度，以及每位受測者整體適應空間焦慮的能力，有效的連結空間能力與車用導航系統之可用性。本計畫應用實驗設計，探討性別在操作車用式導航系統上的差異，以客觀量測調查受測者與導航機之間的互動情形。研究結果顯示，性別確實於操作績效上產生顯著差異，男性在操作的績效上優於女性。男性與女性於空間能力上也存在顯著差異，男性有較佳空間能力。過去車用導航系統介面設計的文獻大多為藉由問卷詢問受訪對象或是藉由模擬設計的機台來針對功能介面的排版設計、功能介面應用提出設計的準則，本計畫之實驗設備採用市面上所銷售之車用導航機台，更能貼近現實操作情況，本計畫除了提出功能介面的設計改善外，也納入性別、空間能力、車用導航系統三種解釋變數進行分析，探討不同的使用族群是否在使用操作車用導航系統上會有所不同。隨著車用導航系統銷售量的成長，使其逐漸成為駕駛人行車上重要的車載配備，本計畫課題顯得格外重要。本計畫證實男性與女性確實在操作車用導航系統介面時產生差異，並根據觀察受試者操作情況以及受試者所建議之回饋後提出介面改善的建議，減少使用者操作上的不便，提升使用效率。對於駕駛人而言，過多的設定步驟、點擊介面反應速度過慢以及操作的不便性皆容易讓駕駛人注意力分散，進而影響行車安全，妥善的介面設計有助於駕駛人操作上順利，減少行車上的風險。本計畫介面改善之建議可提供相關業者參考，有效提高整體操作效率，或是提供消費者做為購買決策參考。

關鍵詞：性別差異、空間焦慮、可用性、能力、Rasch 模式

Abstract

This project integrated the user interface of automotive on-board navigation systems with gender, to analyze whether gender differences, space anxiety or 2D (2 dimensional) vs. 3D (3 dimensional) display affect the operational performance of an on-board car navigation system (CNS). 600 study participants performed a route-locating task on a car navigation system and self-reported their competence to adapt to spatial anxiety using the Spatial Anxiety Scale. The project found gender predicted operational performance: female participants needed more time to perform the designated navigation task than male participants; CNS interface design predicted CNS operational performance; and participants' competence to adapt to spatial anxiety did not predict CNS operational performance. The study's results provide manufacturers and marketers with reliable information regarding at whom they should target their CNS products and whether manufacturers should develop interfaces that fit small-display CNSs based on gender. Study findings also play an important role in determining CNS adoption for drivers.

Keywords: on-board unit; 3D display; genders; spatial anxiety; CNS operational performance; Rasch model.

二、緣由與目的

In Thanksgiving 2010, the AAA (the American Automobile Association, Inc.) estimated that some 32 million Americans would travel by car at least 50 miles from home. A navigation system offering real-time traffic reporting or having voice-guided direction is at the top one of consumers' 10 favorite car accessory features, and can mean the difference between arriving at the destination refreshed and longing for home before reaching the freeway (Kelsey, 2011). In 2010, approximately 48.3 million portable navigation device units and 9.8 million car navigation system (CNS) on-board units (OBUs) were shipped worldwide. It is predicted that the global demand for portable navigation units will increase between 2011 to 2015 at a compounded annual growth rate of 10.7%, mainly in China (YANO Research, 2011). Although traffic congestion is valuable referential information for drivers, and influences their route choices (Dia, 2002; Yin, Lam and Ieda, 2004), it greatly increases the amount of information presented to drivers and thus may add to their workload (Uang and Hwang, 2002). In Japan, the National Police Agency investigated reasons for car accidents in 1999 and concluded that navigation system usage gave rise to safety concerns. Green (2001) therefore proposes the fifteen-second rule, the maximum time recommended for drivers to complete navigation-related tasks involving visual displays and manual controls in a moving car, since driver inattention is one of the most common causes of traffic crashes, as demonstrated by statistical data (Chittaro and Marco, 2004). As well as improving the display technology, a good CNS interface should decrease the possibility of driver distraction and increase drivers' ability to rapidly understand the information shown on the small CNS display (Lin and Chien, 2010). Since drivers' behavior is largely influenced by the presence of information about route selection, it is important to analyze and evaluate the human interface of an in-vehicle information system from the point of view of driver safety (Daimon and Kawashima, 1996). Research on the usage of in-vehicle navigation systems needs to be carried out to examine if it affects driver performance and highway safety (Uang and Hwang, 2002; Dalton et al., 2012). According to Mick and Fournier (1998), only a minuscule amount of research has devoted to investigating consumer behavior after technology has been acquired.

Complex usage logic or the incomprehensible behavior of a system interface diminish self-efficacy and tend to create a sense of user incompetence (Jarvenpaa, Lang and Tuunainen, 2005). When interacting with complex menu structures, users may need to build up a mental representation of the spatial structure of that menu to orient themselves. The structure and design of menus is a main focus of human computer interaction research, which primarily concentrates on analyzing users' menu navigation. Users can get lost in a menu system, not know where they are, where to go next, and how to get back to previous navigation routes or known parts in the menu. This especially applies to menus implemented in small screen devices, presumably because of the restricted screen space, where users only see parts of the menu they have to navigate through. Since the small screen of a CNS shows only a few functions, users do not experience how the menu is structured and how the functions are arranged within the menu (Ziefle and Bay, 2006). Jarvenpaa et al. (2005) make the following comment in their study:

As people are using their newly acquired, technology enabled competency to perform new tasks or try to perform tasks better, they soon experience a new sense of incompetence. Seemingly simple services turn out to be hard to use and newly gained efficiencies tend to be limited in scope and actually cause inefficiency at some higher level. Users explore new device functions or try out new application services with the expectation of becoming a more competent user, only to be confronted with unexpected difficulties that leave them feeling less competent than before.

This implies that the newly acquired competence of operating the CNS while driving can make the user a bad and possibly dangerous driver. It also leaves the user with the impression that the CNS itself is incompetent, or worse, it makes the user feel incompetent as they struggle to make effective use of it. Poor design or technical limitations like small screen size or the tiny input keys of a CNS can render its service ineffective and make it appear incompetent.

In successful wayfinding navigation, people first need to orient themselves in space, that is to say, they need to know where their location is and in which direction they are heading. They then need to plan a route with an understanding of where the destination is located. Finally, they execute the planned route to the destination. People access stored knowledge about the surrounding space, or refer to navigational aids such as maps (Ishikawa et al., 2007). Map-reading requires spatial ability. High-spatial -ability individuals are likely to have good map-reading skills. In contrast, low-spatial-ability individuals are likely to read maps poorly and make less accurate navigational decisions (Wochlnger and Boehm-Davis, 1995). Various definitions have been offered to describe spatial ability. Rafi et al. (2005) define spatial ability as spatial cognition, spatial intelligence, spatial reasoning, and spatial sense. According to Lawton (2010), spatial abilities refer to the cognitive processes involved in locating targets in space, perceiving distance and directional relationships, and mentally transforming objects with respect to their position or orientation in space. Spatial ability is involved in navigational aspects of the driving task, including route-following and map-reading, and requires a range of spatial skills, such as recognizing terrain, being aware of one's direction and orientation, and comparing the spatial features of the real-world to their representations on navigational aids. Navigational skill is reported to be influenced by spatial ability, perceptual speed, and the type of navigational aid (Wochlnger and Boehm-Davis, 1995).

Kozlowski and Bryant (1977) find that accurately pointing to imaging landmarks was positively associated with a self-reported "sense of direction," which is related negatively to spatial anxiety (worry about becoming lost). The experience of disorientation has long been of interest to psychologists, and has been described as a source of annoyance, confusion, and frustration, whereas the ability to maintain environmental orientation has been linked to feelings of personal efficacy or competence (Lawton, 1994). Schmitz (1997, 1999) investigates the relationships between anxiety, way-finding behavior, and the acquisition of environmental knowledge in adolescents. Students who rated themselves as having higher levels of anxiety, conducted wayfinding in an unfamiliar environment more slowly than less anxious ones. Highly anxious participants also tended to use a higher proportion of landmarks than route directions in maps and descriptions of this environment. Girls, in general, scored higher levels of anxiety, showed less speed in wayfinding, and recalled a higher percentage of landmarks against route directions compared with boys. These results suggest that spatial anxiety is not only related to self-reported strategy use but also to real world wayfinding behavior and to the acquisition of environmental knowledge.

Wayfinding is goal directed navigation in which people must adopt a strategy to find a target location (Gerber and Kwan, 1994; Saucier and Green, 2002). Women are more likely to report using a route strategy (e.g. ask for directions about turning right or left at particular streets or landmarks), whereas men are more likely to report using an orientation strategy (e.g., ask for directions about whether to go east, west, north, or south) (Lawton, 1994). In giving directions, men are more abstract and Euclidian, using miles and north–south–east–west terms, whereas women are more concrete and personal, using landmarks and left–right terms (Dabbs et al., 1998). Differences in spatial ability between women and men are considered to be among the most consistent gender differences in cognitive abilities (Lawton and Morrin, 1999). Moreover, technology products, engineering designs, and transportation planning have never been designed with gender in mind (Schintler, 2005). Traditionally, the assumption has been that users or travelers are relatively homogeneous in their needs, values, preferences, and behaviors. Importantly, the assumption is becoming increasingly unrealistic and outdated as more women are using motorized vehicles. About 85% of female drivers in the U.S. are in charge of car maintenance, and more than a third (34%) of automotive do-it-yourself customers are female (Babakus and Yavas, 2007). "The Rise of the Sheconomy" shows that the demographic composition of consumers is changing and female consumers are now a powerful component (Luscombe, 2010). Effective transportation planning and product designers need take into account female driving behaviors and guarantee that products will meet their needs.

This study asked participants recruited in Taiwan to use three popular CNS brands: Garmin, TomTom, and Mio. Both genders and the three CNSs were manipulated in a 2x3 factorial design to collect operating time and number of screens of route-planning tasks. Participants were then asked to complete a questionnaire that elicited information concerning their spatial anxiety. The main research questions addressed in this study were whether gender difference or participant competence to adapt to spatial anxiety have an impact on the operational performance of CNSs and whether manufacturers should develop interfaces that fit small-display CNSs based on gender. Section 2 presents a literature review related to users' competence assessment. Section 3 explains the study methods and experimental design, while Section 4 provides an in-depth description of the results derived from statistical analysis. The final section summarizes the findings and includes a discussion of their implications and recommendations for further research.

三、相關文獻

The competence of participants in this study referred to the strength of their aptitude to adapt to spatial anxiety. We employed a cognitive test to assess participants' current ability in order to estimate their future performance of a number of activities (Cronbach and Snow, 1977). Since Spearman proposed classical test theory (CTT) in 1904 (Lubinski, 2004), it has been the main theory underpinning psychological testing, which is used to measure examinees' attitude toward or ability to use test items (Novick, 1966). CTT assumes that every person possesses a true score that reflects the exact value of their ability or attitude. However, since a person's true score cannot be observed, only an observed score, which is assumed to equal the true score with some errors, is available. Moreover, CTT does not provide information regarding the performance of people with varying levels of ability to use the same item. Additionally, CTT estimates of item difficulty across samples are inconsistent (Magno, 2009).

Because CTT has item bias (Bond and Fox, 2007), a modern test theory called item response theory (IRT) was developed (van der Linden and Hambleton, 1997; Embretson and Reise, 2000). IRT explains the relationship between abilities and data obtained from questions using mathematical models. The power of IRT models is that they provide quantitative estimates of both the item difficulty and person's ability on the same continuous true interval scale, even for tests comprising dichotomously scored items. Another advantage of IRT compared to CTT is that the more sophisticated information provided by IRT enables researchers to improve the assessment reliability. IRT clearly demonstrates that precision is not uniform across the entire range of test scores.

Rasch (1960) develops the dichotomous Rasch measurement model, which is frequently considered an IRT model with a one item parameter. Rasch models are built on two basic concepts: 1) a person with greater ability than another person will have a greater probability of solving any item in a test; and 2) one item being more difficult than another item means that, for any person, the probability of solving the second item is greater. Rasch models are used for analyzing data from assessments that measure items such as ability, attitude, and personality traits. Rasch models are employed frequently in psychometrics, the field concerned with the theory and technique of psychological and educational measurement. Application of Rasch models can also provide information on how well assessment questions or items measure a specific ability or trait. Rasch models provide a basis for obtaining the location of a person on a continuum from total scores on assessments.

In the Rasch model, the probability of a specified response (e.g. right/wrong answer) is modeled as a function of the person and item parameters. Specifically, in the dichotomous Rasch model, the probability of a correct response is modeled as a logistic function of the difference between person ability and item difficulty. In this study, each participant g had a unique competence, θ_g, that represented their capability to adapt to spatial anxiety. Each item i had a difficulty level, β_i, that represented the difficulty the participant had in adapting to the spatial anxiety caused by item i. In the Rasch model, participants' competence, θ_g, and item difficulty, β_i, are calibrated on the same scale. If the participant g's competence is greater than the difficulty of item i ($\theta_g - \beta_i > 0$), then the probability of agreeability is greater than 0.5. If $\theta_g - \beta_i < 0$, then the probability of agreeability is less than 0.5. If $\theta_g - \beta_i = 0$, then the probability of agreeability is equal to 0.5.

The polytomous Rasch model (Andrich 1978; 1979) is a generalization of the dichotomous model, and successively higher integer scores represent the increasing level or magnitude of a latent trait (Ostini and Nering, 2006). Under the polytomous Rasch model, the relative difficulty of the steps within an item is assumed to be constant across all items in the instrument, and the items are believed to differ only in their location on the ability scale. The Partial Credit Model (Masters, 1982) has an identical mathematical structure, but is expressed in a form that allows various thresholds for different items. If an item has five response choices (e.g. 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree), it is modeled as having four thresholds. Each set of threshold estimates is unique to the individual item (i.e. threshold k for item i). β_{ik} is the location parameter of the boundary curve between the k th and $k+1$ th response categories. The probability of a person choosing any category on any item as a function of the agreeability of participant g (θ_g) and the endorsement of item i at the given threshold k (β_{ik}) (Wright and Masters, 1982) is as follows:

$$P_{ik}(\theta_g) = \frac{\exp(\theta_g - \beta_{ik})}{1 + \exp(\theta_g - \beta_{ik})}.$$

Rating scales and Likert scales are popular psychological measurement scales that depend on human judgment (Nunnally and Bernstein, 1994). Likert scales, which use a standard set of response options representing the degree of agreement instead of descriptive terms, do not differ fundamentally from rating scales. Both Likert scales and rating scales assume that the human observer is capable of quantitative observation and assigning numbers or objects to reflect the degree of traits or agreement/disagreement with the statements being measured (Hopkins et al., 1990). The merits of rating scales include conciseness, time efficiency, scope of application, and ease of use. However, they are criticized for being too simplistic. First, the raw scores of a rating scale fail to meaningfully measure objects. Meaningful measurement must be linear in order to enable the application of arithmetic and linear statistics. However, raw rating scale scores are ordinal, nonlinear, and sample dependent. Moreover, the nonlinearity of the raw scores, which tends towards central scores and away from extreme scores, indicates that applying any linear statistical method will produce systematically distorted results (Wright and Masters, 1982). To obtain objective and meaningful measurements, raw scores must be transformed into linear measures to enable subsequent analysis and inference. Second, without clear and mutually exclusive distinctions, the options provided by the rating scales can be viewed as linguistic variables. Without clear definitions of the variables, performing arithmetic on linguistic variables exceeds the capability of traditional binary crisp logic. The Rasch model was therefore the preferred method of measurement in this study.

四、研究方法與結果

This study adopted an experimental design to investigate whether gender or the interface design of CNSs leads to differences in user performance. It then employed the Spatial Anxiety Scale (see the Appendix) to assess whether study participants' competence to adapt to spatial anxiety affected their operational performance with regard to using different CNS interfaces. A polytomous Rasch model was used to estimate the participants' competence to adapt to spatial anxiety using data obtained from their responses to a questionnaire. The purpose of employing the model was to obtain measurements from categorical response data. We used WINSTEPS (ver 3.69.1.9) (Linacre and Wright, 2010), implementing the Rasch model to test the data obtained following the assessment and to determine whether they fitted the model. The Joint Maximum Likelihood Estimation (JMLE) method was then iterated to obtain more precise estimates of participants' ability, item difficulties, standard errors, and fit statistics (Baker and Kim, 2004). This section explains how the data were collected.

Because Engström et al. (2005) indicate that visual demand leads to reduced speed and increased lane keeping variation, this study conducted a laboratory experiment to ensure a safe and undisturbed environment where participants could focus on CNS operational performance. The test sessions took place in an isolated room at the National Cheng Kung University in Taiwan. An equal number of participants were randomly assigned to one of three groups to use one of three popular CNS brands with 4.3-inch touch panels, namely: Garmin (nüvi 2465T), TomTom (Moov S409), and Mio (XL IQ Routes). Participants took approximately 30 minutes to complete the experiment, with each participant following specified steps:

1. Orientation session: Each participant attended an orientation session. The objectives of the investigation, a brief explanation of the CNS, and instructions for operating the CNS were presented.

2. Task performance: To randomly assign participants to one of the three CNSs, participants were asked to select a piece of paper from a shuffled pile of papers. Each paper had the name of one of the three CNS brands on it. After selecting a piece of paper from the pile, each participant participated in a 5-minute acclimatization session before executing the actual test tasks. This session provided participants with a general introduction to CNSs and their basic functionality. Participants were asked to complete a routing plan, and the operating time and number of screens of the route-finding result for a designated task were recorded. Participants were allowed to ask for help only once in the course of conducting the experiment.

3. Questionnaire: Participants in the experiment were asked to rate the items of the Spatial Anxiety Scale shown in the Appendix (Lawton, 1994), in order to express their spatial anxiety level. Each response was measured using a five-level Likert scale.

The 600 participants recruited for testing CNS usage all participated in the experiment voluntarily with a small inducement. Both genders were equally represented. Most participants (87.3%) were in the 18-25 age group, thus, were primarily young. More than half of participants (57.7%) had experience in using other portable navigation devices. Further, although all participants had a driver's license, only 39% had practical driving experience.

To measure the competence of participants to adapt to spatial anxiety, the effectiveness of the measurements had to be verified before estimating the parameters. As regards the issue of meaningful measurement, psychological measurement must be unidimensional, linear, invariant, and objective (Rasch, 1960; Linacre and Wright, 1994). A good measurement process allows an ability or latent trait to be estimated individually, and does not confuse two or more human traits into one measure. This focus on individual constructs or dimensions is known as unidimensionality. The diagnosis process analyzes items and participants' competence based on scoring methods and the response data. The Rasch model provides a mathematical description of how fundamental measurements should operate with psychological variables. However, empirical data may not conform to the strict requirements of fundamental measurement. In Rasch measurement, fit statistics enable investigators to detect discrepancies between the Rasch model prescriptions and the data collected in practice (Bond and Fox, 2007). The diagnosis procedures are followed by an item and person fit analysis.

In this study, the principles used to distinguish persons and items from unexpected responses were based on those employed by Linacre and Wright (1994) and Bond and Fox (2007). The acceptable range for the $MNSQ$ value is between 0.75 and 1.3, and the $Zstd$ value should also be within this range (-2, +2). Person and item fitness values outside this range are considered unexpected responses. Rasch analysis programs typically report fit statistics as two chi-square ratios: infit and oufit mean square statistics (Wright and Masters, 1982), where infit is an information-weighted fit statistic that focuses on the overall performance of an item or person, that is to say, the information-weighted average of the squared standardized deviation of an observed performance from an expected performance; and outfit is an outlier-sensitive fit statistic that identifies rare events that have occurred unexpectedly.

The analysis of data was conducted in two stages. First, eight spatial anxiety items were factor analyzed, by factoring the principal components with a Varimax rotation procedure to identify the underlying dimensions of attributes. The Kaiser-Meyer-Olkin (KMO) index of 0.886 (p-value<0.000) indicated that the data were likely to factor well based on correlation and partial correlation, and that the data supported the use of factor analysis. Further, it suggested that the data might be grouped into a smaller set of underlying factors. All eight spatial anxiety items met the 0.5 cut-off point and were included in subsequent analysis. Factor analysis of the eight items resulted in one factor grouping, which explained 47.698 percent of the anxiety item variance. The factor loading was greater than 0.6, indicating a good correlation between the anxiety items and the factor grouping to which they belonged. The relatively high alpha coefficient (α=.842) indicated that the factor was internally consistent (Wright, 1996).

This study also conducted confirmatory factor analysis (CFA) to test whether the assumption that items measured the same unidimensional latent construct was true.

According to AMOS 7.0, the CFA model had a discrepancy of 4.241. The discrepancy divided by degrees of freedom was 1.06. Assuming that this CFA model was correct, the probability of getting a discrepancy as large as 4.241 was 0.374. The χ^2 value indicated that the model fitted the collected data (χ^2 = 4.241, *p*-value = 0.374, and χ^2 /degree-of-freedom = 1.06). The GFI (Goodness-of-Fit Index) (Jöreskog and Sörbom, 1989) and AGFI (Adjusted Goodness-of-Fit Index) values were 0.998 and 0.984, respectively, and the CFI (Comparative Fit Index) (Bentler, 1990), and NFI (Normed Fit Index) (Bentler and Bonett, 1980) values were 0.999 and 0.997, respectively, all indicating a good fit. In addition, the RMR (Root Mean Residual) value of 0.008 and the RMSEA (Root Mean Error of Approximation) value of 0.01 were acceptable. Therefore, the assumption that items measured the same unidimensional latent construct was confirmed.

Further, the standardized residual covariances for the CFA and most of the data were within the range of (-2, +2), and no items violated local independence. The ordered thresholds indicate that, along increasing levels of the continuum, each response option is the most likely option to be endorsed. The assumption of unidimensionality, local dependence, and ordered thresholds in the Rasch model was therefore correct. This meant that the measurement of participants' competence to adapt to spatial anxiety was effective; we could therefore estimate the parameters.

After transforming ordinal raw data into an interval scale using the Rasch model, item difficulty and participants' competence to adapt to spatial anxiety were calibrated on the same scale for subsequent interpretations. In this study, when a study participant agreed that an item caused spatial anxiety, the negatively-keyed item would represent a relatively low level of the attribute. Table 2, displaying WINSTEPS summary statistics, shows that the mean scores for person reliability and item reliability were 0.83 and 0.99, respectively. Both person reliability and item reliability were interpreted as a measure of reliability of the psychometric instrument. The widely accepted social science cut-off is 0.70 for an item set. In this study, both infit *Zstd* and outfit *Zstd* ranged between ±2, indicating that observational responses fitted the model well (Wright et al., 1994). Thus, all items could be used to measure the latent construct of participants' competence to adapt to spatial anxiety. The competence estimate mean of 0.19 provided the first indication that the sample found it comparatively easy to adapt to spatial anxiety because the competence of participants was relatively higher than the item difficulty (0.0).

4. Conclusion

This research had two related objectives. The first was to evaluate driver navigational performance by means of a CNS route guidance display. The second was to evaluate the effects of driver differences in spatial anxiety and gender on navigational performance. These objectives were related because knowledge about the relationship between gender, spatial anxiety, and operational performance can be applied to improve the navigational performance of drivers with varying levels of competence.

To understand the relationship between gender, spatial anxiety, and operational performance, participants self-reported their competence to adapt to spatial anxiety and performed a route-locating task on a CNS. An experimental design was adopted to test whether interaction existed between gender group and operational performance using different CNS interfaces, gender group affected competence to adapt to spatial anxiety, CNS interface design affected CNS operational performance, and competence to adapt to spatial anxiety predicted CNS operational performance. The study focused on three specific outcome variables: (1) the operational number of screens for the designated route-planning task; (2) the operational time of the task; and (3) self-reported competence to adapt to spatial anxiety (in categories). We used the Rasch model to estimate the outcomes and participants' competence was further grouped to high or low competence. Four results were recorded: (1) gender difference affected participants' CNS operational performance and female participants needed more operational time to perform the designated navigational task than male participants; (2) gender difference affected participants' competence to adapt to spatial anxiety and female participants reported lower competence to adapt to spatial anxiety than male participants; (3) the interface design of CNSs affected CNS operational performance; and (4) participants' competence to adapt to spatial anxiety did not predict the CNS operational performance.

The first result is consistent with studies that have reported that males and females possess differences in visual and spatial capacity and males perform visual-spatial tasks significantly faster than females (Maccoby and Jacklin, 1974; Cutmore et al., 2000), and males perform better in tests of map reading skills (Henrie, Aron, Nelson and Poole, 1997). The first result also demonstrated that males appear to have an advantage in computer use oriented towards programming and games (Moffat, Hampson and Hatzipantelis; 1998; Simon, 2001). Men have been reported to be more efficient at finding destinations (Lawton and Kallai, 2002), and faster than women at locating targets with the aid of a map and compass in military orienteering tests (Malinowski, 2001). Males have been found to have higher technical confidence than females of the same age (Ziefle and Bay, 2006) and more computer experience (Terlecki and Newcombe, 2005). A user's gender and technical experience have been reported to play a significant role in determining the operational performance of a system (Rodger and Pendharkar, 2004).

The second result, namely, gender difference affected participants' competence to adapt to spatial anxiety, is in line with studies that have found that women tend to report a higher level of anxiety than men when performing tasks such as trying a new shortcut without the aid of a map or figuring out which way to turn when emerging from a parking garage (Lawton, 1994; O'Laughlin and Brubaker, 1998). This finding is also consistent with previously reported higher self-reports of sense-of-direction or spatial confidence by males and higher reports of spatial anxiety by females in the study conducted by Montello et al. (1999), and the study carried out by Lawton (1994) that women report a higher level of anxiety than men in performing way-finding tasks.

The third result, that the interface design of CNSs affected CNS operational performance, was mainly derived from the designated route-planning task, which was designed to collect information on how users searched for routes on CNS small displays. Participants who used Gamin required more operational time than those who used Mio or TomTom. This result may be explained by the observation that each time Garmin users created a waypoint, they needed to touch more screens to execute navigation to a waypoint. The result is in line with the proposition that a wide-but-shallow menu structure is better than deep links, and that navigation time in the broad structure is shorter than navigation time in the deep structure (Parush and Yuviler-Gavish, 2004; Shneiderman and Plaisant, 2004).

The final result, that participants' competence to adapt to spatial anxiety did not predict CNS operational performance, suggests participants' operational performance was inconsistent with their subjective perception of their competence to adapt to spatial anxiety. Moreover, and importantly, according to this study, participants with low competence to adapt to spatial anxiety, therefore, in high need of help from a navigation system, did not demonstrate difficulty in operating a CNS. The advantage of having a CNS is that it tells drivers how to get to their destination according to the instructions on the screen. Drivers with a good sense of direction have been found to show high competence to adapt to spatial anxiety and to seldom get lost in unfamiliar territory (Kozlowski and Bryant, 1977). This study suggests that an on-board CNS does not work more effectively for such drivers than those with a poor sense of direction. Even though a good sense of direction is clearly advantageous for finding one's way around the environment. Operating a CNS efficiently does not rely upon a sense of geographic direction.

The primary limitations of this study are that respondents used traditional Chinese interfaces and study participants were young people familiar with computer interfaces and cell phone displays. The idea that boys have greater social expectations and prepare for more responsibilities in the future than girls is especially widespread among traditional Chinese people. Based on parental assessment, the prior and present practice of spatial manipulation has been found to be consistently more frequent in boys than in girls (Robert and Héroux, 2004). Boys engage in more contact sports activity (some of which may be spatial in nature) and more "scouting" activity, both of which may be beneficial for promoting spatial competence (Baenninger and Newcombe, 1989). Culture differences in values have been shown to have importance consequences for personality development (Ahadi, Rothbart, and Ye, 2006). Thus, the ability to generalize the results to other populations using different languages or of different ages may be limited. Since smartphones have become exceedingly popular for use as navigation aids and could replace the dashboard navigation system, future studies should conduct outdoor experiments with the help of the GPS to collect objective operational performance data, or investigate whether manufacturers should develop interfaces that fit small-display smartphone-based vehicle navigation systems based on gender.

五、成果自評

本研究成果與計畫書相符，由於本專題計畫補助的經費補助，目前完成初步稿件撰寫，但不便於投稿前完全揭露，本結案報告僅節錄部分內容。

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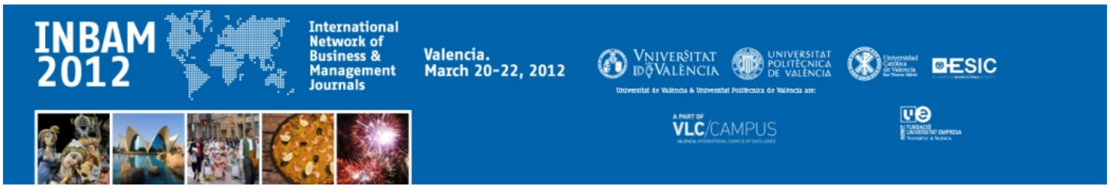
出席國際學術會議心得報告

101　年 3 月 28 日

報告人姓名	林珮珺	服務機構 及職稱	交通管理系副教授
時間 會議 地點	101 年 3 月 20 日 ～ 101 年 3 月 22 日 西班牙，瓦倫西亞		
會議 名稱	(中文)企業與管理國際網路 2012 研討會 (英文) International Network of Business and Management 2012 Conference		
發表 論文 題目	(中文)數位媒介推銷易腐性商品引發之消費衝動 (英文) Buying Impulse Triggered by Promotions of Perishable Commodities and Services Through Digital Media		

一、參加會議經過

企業與管理國際網路 2012 研討會主要活動為期 03/20～03/22 三天（如圖一），地點在西班牙瓦倫西亞，主要會場位於瓦倫西亞大學基金會（如圖二）。後學於 2012 年 03 月 18 日搭乘中華航空公司 CI0937 班機，由小港機場出發，抵達香港國際機場後等待約 4 小時，期間很幸運遇到同校管理學院老師，以及數位外校的學者與博士生，目的地與後學同樣都是到同樣西班牙瓦倫西亞、準備參與企業與管理國際網路 2012 研討會。接著搭乘瑞士國際航空公司 LX139 班機到蘇黎世，由於轉乘的接駁班機需在蘇黎世機場等待六個小時，歐洲聯盟給予台灣免申根簽證待遇，故由機場搭乘 S-Bahn 前往蘇黎世中央火車站(Zurich HB)，乘坐火車 10 分鐘即從機場到達市中心，交通十分便捷。蘇黎世不愧為經濟文化中心城市，具有舊街區和美麗的建築。當地國民整體素質好，英語普及率極高，後學相當震懾於國民生活水平，回到蘇黎世機場後接著轉機到目的地西班牙瓦倫西亞。



圖一、研討會旗幟

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圖二、研討會場入口

在機場提領行李後，與一路搭乘同樣班機的台灣學者分開，他們計畫搭乘地鐵到市中心旅館，而後學預訂旅館前 50 公尺即是重要的 bus 車站，比搭乘地鐵距離近，故後學獨自去等候公車。分手前，外校老師提醒我獨自一人要保持警戒，當地的治安不是很好，扒手很多，後學開始擔心起接下來的行程。果然，bus 屢等不來，與行程上所說的 15 分鐘一班車截然不同，原本想放棄去搭地鐵時才姍姍來遲。司機緊接著告訴一起等待 bus 而會說西班牙文的乘客，說這輛 bus 不會到我要去的地點，也不會去他要去的地點。那位善心的乘客隨即用不太流暢的英

文向我轉述要換車一事，令後學心中非常忐忑不安。接著 bus 東繞西繞後，終於在某個地點讓我們兩位乘客下車，善心的乘客告訴我要換車搭，等換上另一台 bus 後，司機告訴這位與我一路同行的善心乘客，在哪裡下車後，他用西班牙文一路問路並陪同後學走到原先預計要去的重要 bus 車站前，並叮囑後學住在那附近要小心錢包；以及他是羅馬尼亞人等等。雖然這段波折讓後學對西班牙的第一印象非常差，還是感受到人間處處有溫暖。終於抵達旅館，櫃臺服務人員完全談不上友善，並告知後學他找不到我第二、三天的訂房記錄，除非我能提供證據，否則他沒辦法解決問題等等。後學隨即上網將當初訂房的來往電子郵件轉寄櫃臺，這段小差曲令讓後學對西班牙的印象更加惡劣。三天後退房時，後學向櫃臺索取三日房價的總數，櫃臺告知他們不知道，才瞭解連鎖旅館訂房系統的問題，以及價格並不真如研討會主辦單位所述較為便宜划算。

幾番曲折後將行李放置下榻房間，這時距離離開台灣已經是 28 個小時之後了，隨即步行出旅館希望先探探路，練習如何走到研討會地點，以確定明日早上能準時抵達。一開始就完全找不到準備好的地圖上所說的路標與路名，原本方向感很差的我，當場完全迷失方向，但是遇到越來越多的民眾，為了安全隨著人群前進，原來當天是西班牙瓦倫西亞的花火節（Las Fallas）。以這個盛大的節日來迎接新春，可以稱得上是歐洲最瘋狂的春節之一。Fallas 係指用上了油彩的木頭或紙板雕塑成的巨大人偶模型，在 5 天歡慶結束時，僅留下惟一一具，其餘皆焚毀。後學隨著人群到市中心時，大街小巷到處都是刑警，看到處處實施封路及管制，終於瞭解為何今天幾經波折才抵達旅館。但是後學在市中心一直迷路，問路卻完全沒有遇到可以說英文的人，後學一路盡是接觸到不說英文的西班牙人。西班牙文 (Español) 作為使用人數占世界第二位、聯合國六種作業語言之一的拉丁語族語言，使用人數僅次於漢語，多於英文。後學擔心天色漸晚，在語言無法溝通的狀況下，開始找尋回旅館的路途。

大會分三天分別請 12 本國際期刊主編，進行大會報告，期刊主編多報告各期刊的特色、提供年輕研究人員作為投稿方向的參考建議。本研討會的報名費用高達 550 歐元，惟得以一次見足多位期刊主編，仍是難得的經驗。後學聽完大會報告選擇參與一系列 Service Industries Journal 的場次等與個人研究、教學最直接相關的場次。第二天中午是後學被安排報告場次，一開始早上三位期刊主編（Service Industries Journal Editor: Gary Akehurst；Small Business Economics Editor: David Audretsch；International Journal of Project Management Editor: Rodney Turner）的報告未能準時開始，延遲了接下來分組報告的開始時間、接著分組進行報告時，與會報告的學者時間控制地很差，主編一開始不願意打斷、主編允許下午場次的人插隊等等因素，導致每篇文章分配的時間由 20 分鐘先減為 15、再減為 10 分鐘，完全沒有一致性。後學的報告原本被安排在第二篇、接著改成第三篇、又被更改為第四篇，結束後亦獲得來自法國學者的提問交流。個人報告中獲得與會學者與主持人正面的評價與肯定，回到台灣後亦接獲特刊主編邀請在三月 30 日至線上系統正式投稿之信函。

二、與會心得

企業與管理國際網路 2012 研討會能夠邀集 12 本期刊主編共襄盛舉，但參與人員偏重西班牙當地學者。西班牙學者的英文之難以理解、本次大會流程組織的與流程的不完善，幾乎是後學參加過的研討會中最離譜的。與會人員完全無法安排好時間，往往錯失自己有興趣參與的報告主題。近一兩年，隨著後學參加的研討會數量增加，逐漸產生的心得在參與本次研討會亦觀察到相同的現象。往往大家有興趣的是新穎的主題，而非執行地四平八穩的研究報告。以題材來說，若不夠新穎有趣，往往無法吸引與會人員耐心聆聽、更遑論提問交流。後學未來在準備研討會論文時，方向將更加明確。

三、考察參觀活動(無是項活動者省略)

主辦單位於研討會第二天晚上，舉辦瓦倫西亞市中心的巡禮、參訪行程。但後學連續兩天在瓦倫西亞的迷途中，已經不斷反覆經過要參觀的景點，雙腳行走略有困難，故放棄此次參觀行程。第三天亦即最後一天晚上，大會安排晚宴，為避免學校教學工作延宕過多，儘速回到台灣上課，因此未參加。參與本次研討會，讓後學體認到歐盟國家普遍去工業化，此次造訪的西班牙其工業地位不斷下降，產品國際競爭力變弱。西班牙中小企業多，普遍具有創新能力弱、產品附加值低、勞動密集等特點，容易轉向勞動力更低廉的發展中國家。西班牙長期缺乏對具備發展潛力的產業強有力的政策支援，在房地產泡沫期間，大量資本和就業流向地產業。去工業化削弱了西班牙製造業的國際競爭力，對國內就業產生了很大的消極影響。特別是在世界經濟衰退的背景下，大大削弱了西班牙應對危機的能力。雖然仍有大量外國人士造訪以陽光及古蹟聞名於世的西班牙，惟西班牙主要大城如馬德里、巴塞隆納、塞維亞市之治安皆急速惡化，搶竊案件頻傳。尤其在地鐵上看到在車廂內站崗維持秩序的警察、背包背在身體前方的當地人，可想見當地治安之惡劣。西班牙雖號稱歐洲第 6 大經濟體，世界排名第 12，在歐洲僅次於傳統強國德國、法國、英國、意大利和俄羅斯，但事實上，西班牙經濟過於依賴旅遊業為主的服務行業，缺乏競爭力。

四、建議

非常感謝邁向頂尖大學計畫與國科會所提供之補助，使後學得以出席本次學術會議，從中獲得與其他國內、外學者討論的機會，深感不虛此行。國內若能持續積極補助、鼓勵研究人員或學者參與國際研討會，營造研究人員更佳的研究環境，並與國際學術交流、接軌，作專業上交流，必能提升研究水準與國際能見度。

五、攜回資料名稱及內容

大會議程、論文集隨身碟、企業與管理國際網路 2013 研討會將於葡萄牙舉辦 Call for paper 的訊息。

六、其他

無。

出席國際學術會議心得報告

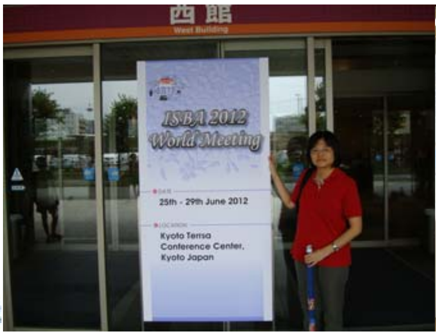
101　年 7 月 3 日

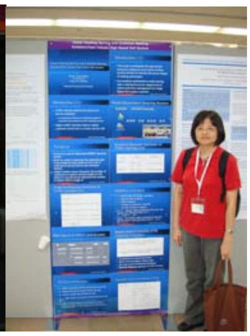
報告人姓名	林珮珺	服務機構 及職稱	交通管理系副教授
時間 會議 地點	101 年 6 月 26 日 ～ 101 年 6 月 29 日 日本京都		
會議 名稱	(中文)貝氏分析國際社群 2012 研討會 (英文) 2012 International Society for Bayesian Analysis		
發表 論文 題目	(中文) 台灣高鐵售票服務與顧客等候 (英文) Ticket Vending Service and Customer Waiting: Evidence from Taiwan High Speed Rail System		

1. 參加會議經過

本次日本行的目的旨在參加第十一屆貝氏分析國際社群研討會(2012 ISBA)(如圖一、二、三),ISBA為三個重要國際貝氏大會之一。貝氏統計(Bayesian statistics),雖然不是方法論或統計學上的新觀念或新產物,但是應用於社會科學的量化研究傳統卻有極大的潛力。貝氏推理提供了一個合乎邏輯的定量過程,被廣泛應用在科學,技術和決策分析。ISBA成立於1992年,以促進貝氏分析的發展與貝氏分析在科學,產業和政府的有效應用。通過贊助和大會會議,出版了貝氏分析期刊,以及重要的教學推廣活動,ISBA為那些在貝氏分析及其應用感興趣的議題提供了一個聚會與發表場合。

本學術會議為期五天,後學未能在研討會正式論文徵稿期限前得知此研討會將在日本舉辦之訊息,緊急投稿後經過論文的審查,僅來得及參與張貼海報的會議場次。先前參與研討會經驗,讓後學覺得能參與口頭報告與只是張貼海報略有高下之分,不過經過這次張貼後學想法略有改變,由於安排場地於12:30即開放張貼海報,正式顧攤位的時間為下午18:00開始,透過一整個下午與晚上時間慢慢閱讀各與會學者的研究內容、呈現方式,收穫並不遜於在15分鐘內要理解一個研究的口頭報告,尤其要在那麼短的時間內得克服報告人員在英語口說上的差異。





圖一　　圖二　　圖三

2. 會後心得

自從後學順利將稿件寄出並接獲可參與大會通知後,在會議舉辦前即不斷接獲來自會員組織提供的各項有關貝氏分析的教學、應用課程的訊息通知,每次訊息都讓後學愈來愈認同貝氏分析國際社群的嚴謹與對會員的各項服務。研討會在三天主要的會議中,每天都安排一位貝氏分析領域的重要學者擔任主講員(Keynote Speaker)進行大會主題報告,讓與會人員可以聆聽到五場為時45分鐘的大型演講。演講主題分別涵蓋資料同化與序列貝式分析過濾、癌症基因體研究的應用、以及無母數與條件分佈等。

非常感謝國科會所提供之補助,使個人得以出席本次學術會議,從中獲得與

來自國內、外學者討論的機會，深感不虛此行。本次會議地點在日本，為了提升競爭力或是國民素質之緣故，日本企業一向追求精緻化或更好的服務。不論是否只是表面上的有禮貌或客氣，與之大異其趣的是國內隨處可見的冷漠從業人員，臉上掛著的永遠是不高興與對工作失去的熱情，除非按照他的要求付出金錢。台灣人民的平均值是無論生活富不富有，生命、心靈普遍都貧窮。生命的原則到底是什麼？一個人的價值能不能不只靠金錢定義。在去日本的班機上，遇到一些機械上的問題，出於安全性的考慮，機長決定放棄起飛，在跑道上滑行，本打算折回停機坪，延誤了將近一個小時。由於過程中，機長忙於處理緊急事件，無法即時向乘客說明，大家都在不安中等待，直到有一位旅行團的遊客離開座位站起來向空姐發怒，大罵中華航空公司，雖然空服員並未回嘴，努力安撫該乘客情緒性的發言，但空服員明顯在忍耐自己不高興的話語意味。之後機長才向大家廣播說明事情經過，更是引發乘客的恐懼。

今年度的出國經費分別到西班牙瓦倫西亞與日本參與兩場研討會，但限於國科會經費用途無法變更或流用，必須自費再墊上四萬元左右。在國內教書十年的時間，後學希望努力維持胸襟與眼界的開闊，更一直惶恐無法跟上學術研究快速前進的腳步，而被環境淘汰。故衷心地感謝國科會持續積極補助經費、鼓勵研究人員或學者參與國際研討會，營造研究人員更佳的研究環境，並與國際學術交流、接軌，作專業上交流，使研究水準與國際能見度得以提升。

3. 考察參觀活動(無是項活動者省略)

略

4. 建議

無

五、攜回資料名稱及內容

大會議程、研討會紀念袋。

六、其他

無

國科會補助計畫衍生研發成果推廣資料表

日期:2012/11/27

國科會補助計畫	計畫名稱: 性別差異於空間焦慮與車載式導航系統可用性之影響—比較2D與3D介面
	計畫主持人: 林珮珺
	計畫編號: 100-2629-E-006-001- 學門領域: 性別主流科技計畫

無研發成果推廣資料

100 年度專題研究計畫研究成果彙整表

計畫主持人：林珮珺	計畫編號：100-2629-E-006-001-
計畫名稱：性別差異於空間焦慮與車載式導航系統可用性之影響—比較 2D 與 3D 介面	

成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比		
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	1	1	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	2	2	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	0	1	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	無

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

■達成目標

□未達成目標（請說明，以 100 字為限）

□實驗失敗

□因故實驗中斷

□其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文：□已發表 ■未發表之文稿 □撰寫中 □無

專利：□已獲得 □申請中 ■無

技轉：□已技轉 □洽談中 ■無

其他：（以 100 字為限）

本研究結合使用者的性別差異與空間焦慮程度，並考量受測者個別空間能力的差異與空間焦慮來源的難度，探討是否因為性別差異而有所不同，並研究受測者在車用導航系統介面的操作上的績效，了解性別差異於介面可用性的影響。本計畫初步成果於 2012 年 5 月，已正式於 ICIM2012 第 23 屆國際資訊管理學術研討會進行口頭報告。本研究成果與計畫書相符，由於本專題計畫補助的經費補助，目前已完成稿件撰寫，並已投稿至 SSCI 期刊，但不便於投稿前完全揭露投稿內容與數據，本結案報告僅節錄部分內容。

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

本計畫考量受測者個別能力的差異與空間焦慮來源的難度，使用 Rasch 模式，有效估算出個別焦慮來源造成受測者之感受程度，以及每位受測者整體適應空間焦慮的能力，連結空間能力與車用導航系統之可用性。分析不同性別所具備的空間能力，以及探討性別差異是否影響車用導航系統介面使用性。過去車用導航系統介面設計的文獻大多為藉由問卷詢問受訪對象，或是模擬設計的機台針對功能介面的排版設計、功能介面應用提出設計的準則，本計畫之實驗設備採用市面上所銷售之車用導航機台，更能貼近現實操作情況。本計畫除了提出功能介面的設計改善外，也納入性別、空間能力、車用導航系統三種解釋變數進行分析，探討不同的使用族群是否在使用操作車用導航系統上呈現的差異。文獻中探討空間能力影響功能選單介面的操作，大多集中在電腦選單介面或手機與 PDA 等行動裝置，較少有研究針對車用導航系統裝置進行探討。隨著車用導航系統銷售量的成長，逐漸成為駕駛人行車上重要的輔助工具與汽車製造商預設的車載配備，本計畫課題顯得格外重要。本計畫證實男性與女性確實在操作車用導航系統介面時產生差異，並根據觀察受試者操作情況以及受試者所建議之回饋後提出介面改善的建議，減少使用者操作上的不便，提升使

用效率。對於駕駛人而言，過多的設定步驟、點擊介面反應速度過慢以及操作的不便性皆容易讓駕駛人注意力分散，進而影響行車安全，妥善的介面設計有助於駕駛人操作上順利，減少行車上的風險。本計畫介面改善之建議可提供相關業者參考，有效提高整體操作效率，或是提供消費者做為購買決策參考。本計畫為在室內進行導航系統介面操作，並未接收衛星訊號，與實際使用情形有所差異，建議未來研究實際在真實駕駛環境中使用車用導航系統，並納入受測者操作導航機時的心跳數、眼睛扎眼頻率等生理反應變數，研究受測者所呈現之使用行為的差異。本計畫於實驗操作使用的機台，選擇主流市場的 3.5~5 吋導航機。顯示介面過小，容易造成使用者眼睛的疲乏與困擾，已有 6~7 吋的觸控螢幕介面的推出，因此未來研究可建議針對較大尺寸的導航機進行介面差異的探討。此外智慧型手機逐漸普及化，結合了諸多附加功能，包括導航功能，市場也預估車用導航系統未來的市占率將會被智慧型手機瓜分，建議未來研究可以將智慧型手機導航功能納入比較，是否在操作使用上與車用導航系統有所差異。