



# What drives hospital wards' ambidexterity: Insights on the determinants of exploration and exploitation

Emanuela Foglia<sup>a</sup>, Lucrezia Ferrario<sup>a</sup>, Emanuele Lettieri<sup>b,\*</sup>, Emanuele Porazzi<sup>a</sup>, Luca Gastaldi<sup>b</sup>

<sup>a</sup> LIUC – Università Cattaneo, Italy

<sup>b</sup> Politecnico di Milano, Italy

## ARTICLE INFO

### Article history:

Received 8 August 2018

Received in revised form 9 September 2019

Accepted 8 October 2019

### Keywords:

Ambidexterity  
Exploration  
Exploitation  
Hospital  
Innovation  
Creativity  
Efficiency  
Quality  
Improvement  
Leadership  
Organizational Support  
Organization  
Strategy  
Change management

## ABSTRACT

**Objectives:** Hospital wards are required to exploit current knowledge and explore for new knowledge. Ambidexterity (i.e., the capability to combine both exploitation and exploration) is a major issue in healthcare as result of the growing expectations that hospitals wards have the capability to manage the trade-off between high-quality delivery of care and cost-containment. This study sheds novel light on the determinants of ambidextrous behaviours in hospital wards.

**Methods:** A theoretical framework has been built on the extant literature. The main determinants of ambidexterity are opening/closing leadership, organisational support, organisational creativity and environmental dynamism. The model has been tested empirically through data collected via survey administered to head physicians in charge of hospital wards. After the quality check, 80 questionnaires were available for the statistical analysis based on a hierarchical sequential linear regression model (with enter methodology).

**Results:** Results showed that opening ( $\beta = 0.389; p < 0.001$ ) and closing ( $\beta = 0.288; p < 0.01$ ) leadership, as well as organisational creativity ( $\beta = 0.499; p < 0.001$ ) are necessary to materialize ambidextrous behaviours ( $\text{Adj.}R^2 = 0.529$ ). Environmental dynamism does not moderate these relationships. While opening leadership ( $\beta = 0.375; p < 0.01$ ), organisational creativity ( $\beta = 0.270; p < 0.05$ ) and environmental dynamism ( $\beta = 0.224; p < 0.1$ ) are determinants of exploration, closing leadership ( $\beta = 0.506; p < 0.001$ ) and organisational creativity ( $\beta = 0.529; p < 0.001$ ) are determinants of exploitation.

**Conclusions:** Head physicians' leadership style as well as organizational creativity play a pivotal role in materializing ambidextrous behaviours in wards.

© 2019 Elsevier B.V. All rights reserved.

## 1. Introduction

Slow economic growth in recent years has restrained both public and private financial resources, making it difficult to meet healthcare needs worldwide [1]. These financial constraints have affected hospitals, which are required to improve both the quality and the efficiency of their services [2]. As a result, healthcare professionals have to rethink care delivery [3] according to the human and economic resources available, and by managing the tensions between high-quality and safe delivery of care and cost containment [4,5].

\* Corresponding author at: Politecnico di Milano, Department of Management, Economics and Industrial Engineering, Via Lambruschini 4/b, 20156 Milano (MI), Italy.

E-mail address: [emanuele.lettieri@polimi.it](mailto:emanuele.lettieri@polimi.it) (E. Lettieri).

These tensions emerge as result of the strategies implemented in hospitals to enable both exploratory and exploitative behaviours [6]. While exploration plays a pivotal role in experimenting and looking for novelty and innovation [6], exploitation is salient to recombine current knowledge and abilities for meeting new needs in settings characterised by a paucity of resources [2]. Enabling both explorative and exploitative behaviours over time can be particularly complex [6,7]. In fact, while exploitation refers to refinement and efficiency, exploration is deemed as discovery and searching [8].

As a result, hospital managers are nowadays focusing their attention on how to balance their explorative and exploitative efforts [2,9], striving to develop ambidextrous organisations [10]. Ambidexterity is defined as the ability to both use and refine existing knowledge (exploitation) while creating new knowledge to overcome knowledge gaps identified in the execution of the work (exploration) [10], thus demonstrating “alignment and adapt-

ability across an entire business unit” [11]. Despite the urgency and relevance of this topic [12,13], very little is known about the mechanisms that might fuel ambidextrous – i.e., explorative and exploitative at the same time – behaviours in hospitals [14].

Hospital wards represent the most correct unit of analysis to investigate ambidexterity in the healthcare domain. In fact, wards have complex internal dynamics, requiring a high level of coordination among different professionals, who have to combine exploratory and exploitative efforts on a daily basis [14]. In addition, since ambidexterity is a wide and complex process, studying it in an entire hospital would introduce too many confounding factors in the analysis.

Moving on from these premises, this study aimed at investigating the inner mechanisms that might be conducive to ambidextrous behaviours in hospital wards. An ancillary objective was to investigate the inner mechanisms influencing either exploitation or exploration as independent behaviours in hospital wards.

The results of this study are original and contribute to further the ongoing debate on how to sustain performance improvement and innovation in hospitals, as well as to provide hospital managers with evidence-based insights on how to enable ambidextrous behaviours.

## 2. Research design and theoretical background

Grounding on past contributions on ambidexterity [e.g.: 2,14–17], four constructs were taken into account, as independent variables that might explain the inner mechanisms that enable ambidextrous behaviours. They are: (i) opening and closing leadership, (ii) perceived organisational support (POS), (iii) organisational creativity (OC), and (iv) environmental dynamism (ED). These factors have been found to play a relevant role in other sectors, with a significant demonstrated impact on the achievement of ambidextrous behaviours. In this view, we assumed their relevance also in healthcare – with particular focus to hospital wards – and accordingly, we designed a study for empirically testing our hypotheses. The lack of specific evidence about what drives ambidexterity within the healthcare setting, we had to develop hypotheses based on findings in other domains but healthcare. Testing the replicability of the same findings within the healthcare setting – and verifying the validity of our hypotheses –, we gathered evidence about what hospital managers should do to enable ambidextrous behaviour in the hospital wards, thus allowing the exploration of new knowledge for improving the delivery of care, as well as the exploitation of current knowledge for the same purpose [2,8].

### 2.1. Opening and closing leadership

Leadership is a process of social influence by which a person can enlist the aid and support of others to accomplish a common task [15], and could be described as an important predictor of innovation [16]. An ambidextrous leader is able to foster both exploration and exploitation in followers, by increasing or reducing variance in their behaviours and flexibly switching between those behaviours [17]. This behaviour, also described in other industries and settings, is both valid and problematic for the healthcare context.

The role of leadership may be distinguished into two specific factors [17]. Opening leader behaviour includes doing things differently and experimenting, giving room for independent thinking and acting, and supporting attempts to challenge established approaches. As result, professionals are allowed to experiment and develop breakthrough innovations [17]. This has been found in many different settings, and we assume that it works similarly in healthcare. Conversely, closing leader behaviour includes taking corrective actions, setting specific guidelines, and monitoring

goals achievement. A closing leader also aims to conduct efficient activities devoted to the achievement of specific and clear-cut goals, leveraging exploitation [17]; for example, the achievement of budget objectives for an hospital ward.

Thus, a well-managed hospital ward presents the coexistence of both opening and closing leadership. A hospital leader can foster exploration by opening behaviours and exploitation by closing behaviours, and flexibly switching between these according to situational task demands [18], balancing the need to be efficient and effective in the healthcare processes.

The following assumptions were therefore proposed:

- $H_{1,A}$ : in a hospital ward, opening leadership presents a positive impact on exploration, due to the continuous development of innovative technologies and processes to improve the quality of healthcare services;
- $H_{1,B}$ : in a hospital ward, closing leadership has a positive impact on exploitation, guaranteeing the focus on goal achievement and efficiency;
- $H_{1,C}$ : both opening and closing leadership have a positive impact on ambidexterity in a hospital ward, balancing the needs to achieve efficiency and innovate.

### 2.2. Perceived organisational support

Perceived Organisational Support (POS) measures how organisations directly benefit from employees, as well as how employees show commitment to the organisations [19].

POS is an important antecedent of ambidexterity in healthcare organisations, especially for what concerns how a professional feels in operating “in and out” of their competencies. Age, role and work experience of medical staff could influence the level of POS [20]. In particular, greater exposure to the requests of hospital management and negative work experience could generate resilience to change management, thus having a negative impact on POS.

In addition, the nature of the healthcare organisation could be a factor influencing POS [20]. University hospitals and healthcare organisations devoted to research activities could better support exploitation, due to the higher level of knowledge concerning research [21]. Literature states that POS could support the continuous learning development of any healthcare organisation, fostering innovation processes [19,22]. Research [23] has revealed the capability of POS to assist and sustain healthcare decision-makers in the formal redesign and evaluation of patient processes, thus optimising their clinical pathway, achieving a higher efficiency, and leveraging exploitation activities. Therefore, POS is strategically relevant in hospital settings, being related to the quality of results achieved, spending less time for their achievement [19], and impacting hospital policies [24].

With regard to POS, the following hypotheses were therefore defined:

- $H_{2,A}$ : in the healthcare sector, POS has a positive impact on exploration, leveraging the fact that hospital wards are knowledge-intensive structures, even in the case of general rather than research institutes;
- $H_{2,B}$ : in a hospital ward, POS has a positive impact on exploitation, fostering improvement in the efficiency of the clinical pathway and hospital activities;
- $H_{2,C}$ : as a result, in the healthcare sector, POS should demonstrate a positive impact on ambidextrous behaviours, leveraging both exploitation for efficiency, and exploration for continuous learning and quality improvement.

### 2.3. Organisational creativity

Organisational Creativity (OC) is the capability to develop novel and potentially useful ideas [25]. Hence, employee creativity often represents the starting point towards innovation and ambidexterity [26]. Literature shows that, in a dynamic environment, OC is perceived as a possible source of advantages to organisations [27]. In healthcare, the desire to suggest new and creative solutions is often linked with high risks and unknown effects. Therefore, a good trade-off is required between clinician requirements, quality of care, the need for constant learning, and innovation [28].

OC enables employees to enhance their organisations' performance, thus seeking out innovative technologies, processes, procedures and ideas [27]. It could also have a positive impact on time constraints and available resources, thus achieving efficiency [29,30] and supporting healthcare professionals in solving clinical, communicational and organisational problems. Although new knowledge could influence exploration activities, it could have a negative impact on performance, requiring attention to continuous improvement of existing resources and processes, and leveraging exploitation activities [31]. The following hypotheses were therefore formulated:

- $H_{3,A}$ : in an hospital ward, a dynamic and knowledge-intensive environment, OC positively impacts exploration behaviours of clinicians, healthcare professionals and employees in general;
- $H_{3,B}$ : in the hospital setting, OC positively influences resource and efficiency management, impacting exploitation behaviours;
- $H_{3,C}$ : implementing OC in solving problems, from communicational, economic, clinical and managerial points of view, presents a positive impact on ambidextrous and divergent behaviours, both coexistent in the decision-making process of high complexity context.

### 2.4. Environmental dynamism

Environmental Dynamism (ED) is defined as the degree of change and level of unbalance in the external context [32], impacting acquiring and developing new competencies [33]. The coexistence of exploitation and exploration may be considered essential for the implementation of good organisational strategies [33]. This is especially true in the healthcare sector, in which introducing process and clinical innovations could significantly modify the working flows and the final outputs and outcomes for patients. For example, an innovative drug for patients who could not receive other therapies could modify their clinical pathway. In the absence of treatment, such patients could die – the worst clinical outcome, without solution, and incurring expenditure for the system. The introduction of the new treatment could completely modify the clinical pathway, improving patient outcomes, and decreasing the level of hospital costs. This type of change depends on the typical healthcare ED.

Evidence demonstrates that exploration and exploitation have a positive relationship with ED since turbulence and pressures towards care improvements should stimulate innovation [14]. Indeed, under some dynamic conditions, the appropriate response to environmental change is a renewed focus on exploring innovative activities, as well as exploiting existing knowledge and opportunities [34], to positively influence the coexistence of both behaviours.

The following hypotheses concerning ED were defined.

- $H_{4,A}$ : in the hospital setting, ED has a positive and pushing impact on exploration activities;

- $H_{4,B}$ : in a hospital ward, ED also has an influence on the existing knowledge and processes, leveraging on exploitation opportunities;
- $H_{4,C}$ : because ED in the healthcare sector influences both exploitation and exploration positively, it could impact on ambidextrous behaviours.

ED may also be conceived as a moderator of the relationship between leadership, POS, OC, exploration and exploitation [14]. In this case, dynamic environments such as hospitals are characterised by unpredictable and rapid changes [32,35], derived from external pressures such as laws, delivery of services, industries, patient needs and organisational reforms.

These dynamic changes, coming from the external environment, and being difficult to foresee, could negatively affect the hospital's internal processes, as well as the organisational efficiency and willingness to innovate of the entire healthcare organisation, reducing POS and OC.

When exposed to such constant changes and modifications, organisations need to look elsewhere for new ideas, or to solve internal problems, finding new opportunities externally [14,36–38]. In these conditions, hospital leaders could experience high levels of stress and anxiety [39], with a negative impact on their working activities.

These considerations could limit the achievement of ambidextrous behaviours, decreasing both the capability to work efficiently and the capability to foster innovation [40,41].

The following hypotheses were therefore proposed:

- $H_{5,A}$ ;  $H_{5,B}$ ;  $H_{5,C}$ : ED limits the capability for hospital leaders to foster innovation and work in an efficient manner, due to the possibility of high levels of stress and anxiety;
- $H_{6,A}$ ;  $H_{6,B}$ ;  $H_{6,C}$ : ED negatively moderates the relationship between POS and the dependent variables, due to unpredictable changes that could affect internal hospital processes;
- $H_{7,A}$ ;  $H_{7,B}$ ;  $H_{7,C}$ : ED limits the possibility to generate novel ideas, due to the continuous and new laws, patient needs and organisational reforms, thus reducing the relationships between OC and the dependent variables.

## 3. Methods

### 3.1. Definition of the measures

Scales useful to test the hypotheses were selected, because of their validation in the literature, considering both industrial and healthcare fields [17,26,42,43].

In particular, with regard to the independent and dependent variables, Table 1 depicts the constructs used and whose consistency within the healthcare sector was verified.

As suggested by literature [44,45], ambidexterity was calculated as the sum between exploration and exploitation values.

In addition, other dimensions acting as control variables were investigated, in order to have a more complete comprehension of explorative and exploitative behaviours in the healthcare sector. Size of the ward, age of the professionals working in the ward, ownership of the hospital, research orientation of the ward, and hospital strategy represented the control variables under investigation [33,46–50], evaluated as synthesised in the followings:

- Size of the ward, considering the number of full-time equivalent professionals working in the hospital ward [33,47];
- Age of the professionals working in the ward, suggesting the level of average seniority of the ward [48,49];

**Table 1**  
Items used to measure constructs.

Construct	Items
Exploration [29] [1 – completely disagree to 7 – strongly agree]	Interaction with top management to acquire new knowledge Professionals find information on new technologies and protocols by producers Interaction with patients' associations Professional interface regularly with specialists of other structures Professionals face professionals from other units Professionals face professionals from third parties New opportunities to serve our patients are quickly understood Professionals are fast to recognise shifts in the healthcare field Professionals quickly analyse and interpret changing market demands The hospital ward is always updated on changes of the offer in terms of products and services Results of the research are accessible and reviewed by the staff The hospital ward recognises the usefulness of acquiring new knowledge from external sources to improve the existing knowledge Medical staff gain a great understanding through evidence and empirical experiences
Exploitation [29] [1 – never to 7 – always]	The hospital ward acquires systematic knowledge from outside (other hospitals, providers, publications) Professionals of the hospital ward deal with regional and local structures for understanding the evolution of the health sector The medical staff works efficiently in carrying out clinical activities and researches The patient is very important and considered Professionals of the hospital ward have a clear understanding of roles and responsibilities The hospital ward improves the efficiency of its internal processes every year Have different ways to accomplish their duties Experiment with different ideas Take risks
Opening Leadership [17] [1 – never to 7 – always]	Think and act autonomously (limited to its activities and responsibilities) Generate and express their ideas and their points of view Have the chance to make mistakes Learn from their mistakes (learning by doing) Monitor and control the achievement of objectives Establish rules and routines Implement corrective actions
Closing Leadership [17] [1 – never to 7 – always]	Monitor adherence to rules Underline errors for internal growth Adhere to agreed plans and objectives, with hospital management Pay attention to level tasks The hospital management appreciates the contribution that my operative unit/service brings to the entire organisation The hospital management appreciates the innovations brought by my operative unit/service The hospital management listens to all my complaints
Organisational Support [38] [1 – completely disagree to 7 – strongly agree]	The hospital management cares about the wellbeing of my operative unit/service When my ward gets important results, the hospital management recognises its effort The hospital management cares about the satisfaction of the clinicians involved in my ward/service The hospital management is very interested in my operative unit/service The hospital management is proud of the objectives achieved by my ward/service Suggest new ways to achieve goals Propose new ideas to improve the performances Try to implement new technologies, processes, techniques Suggest new ways to improve quality Are a source of creative ideas Are not afraid to take risks
Organisational Creativity [23] [1 – never to 7 – always]	Promote and reward the ideas of other colleagues Exhibit creativity when they have the opportunity Develop appropriate plans for the implementation of new ideas Often have new and innovative ideas Propose creative solutions to solve problems Often have a new/different approach to find a solution for problems Suggest operational innovations to clinical and / or managerial activities fulfilling Clinical practices in our specific healthcare setting are changing or have changed significantly in recent years Patients regularly ask for new procedures/new technologies, and/or services In our setting, the supply of technologies or services for patients is very similar between different hospitals In the healthcare sector of reference there are constant changes regarding clinical practices There have been many changes in the last year Suppliers are constantly changing their offer of technologies and services There is a growing demand for healthcare services delivery
Environmental Dynamism [37] [1 – never to 7 – always]	The decision-making process in the healthcare sector needs to consider a significant number of factors Innovations in healthcare sector could derive from many different directions and trends It is difficult to know the innovations proposed and tested by other colleagues in other hospitals and research institutions It is difficult to obtain information concerning the healthcare market and the related performance In healthcare field, it is difficult to base the decision-making process on reliable information and data (evidence-based information) The operative units/services are aware of the population healthcare needs There is information on healthcare activities and procedures, but data are not always available In healthcare field there are trends related to changes in the services supply Despite many changes in the supply of healthcare services, it is difficult to understand their evolution The planning of healthcare activities is difficult to be predicted and it could be influenced by several factors

- Ownership of the hospital, considering the private or public nature of the organisations;
- Research orientation of the ward, defining the number of research activities with universities or research entities;
- Hospital strategy, evaluating three different approaches to the organisational strategies, as stated in literature [50]: clinical excellence, technology leadership and profit maximisation.

### 3.2. Adaptation of existing scales to the healthcare setting

An exploratory factor analysis was carried out to establish whether changes introduced in the adaptation process for the healthcare sector affected the structure of the scales, thus proving the validity of each construct. In particular, all items presenting a factor loading higher than 0.3 were included in the definition of the variables, because of the maximisation of the variance of each construct. In addition, to ensure their reliability, the assessment of Cronbach's alpha was applied, to investigate how well the items measured the same constructs [51], thus allowing the replicability of the scales in future research activities, proving the freedom of the scale from the random error, and establishing their internal consistency. A value greater than 0.7 was assumed to test items, and create the new variables [52] necessary to verify the hypotheses.

### 3.3. Data collection

The sample was composed of clinicians responsible for managerial functions, all afferent to Italian hospital wards. Once the questionnaire was defined, it was accurately tested by eight clinicians, in order to verify both its consistency in the healthcare setting and its comprehension. In addition, the same eight clinicians were interviewed to gather their perceptions about any difficulties they faced in replying to each domain, thus ensuring that the questionnaire could be easily completed.

After the pilot test, 116 questionnaires were administered. A specific online survey tool was used, a qualitative research instrument, which had the advantage of ease in reaching a large number of people, facilitating the reply process and reducing the response time [53]. Analysing the level of accuracy of the answers collected, 80 questionnaires were taken into account because of their completeness, achieving an effective response rate of 69%.

Besides the personal information of the respondents (gender, age, working organisation, professional role, seniority and working experience), and the related hospital and ward characteristics (type of healthcare organisation, hospital ownership and strategy, total number of clinicians per ward, average age of members working in the ward, and research orientation), the questionnaire was composed of 15 questions using a seven-item Likert scale. In particular, the questionnaire aimed to determine the professionals' insights concerning different domains, following the constructs presented in Table 1.

### 3.4. Data analysis

Since the study involved only one representative per ward, the problem of common method variance was addressed and solved with an *ex ante* (by maintaining the anonymity of respondent) and an *ex post* approach (by conducting the Harman's single-factor test, in order to verify an acceptable level of bias; variance explained from the EFA is less than 50%).

At each step, all items below 50% were deleted from the specific dimension, in order to have more precise and defined measurement scales. All the investigated variables were loaded into an exploratory factor analysis, through an unrotated factor solution [54].

Next, the data derived from the questionnaire were analysed considering descriptive statistics, frequencies and distributions. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasticity.

Inferential analyses were then conducted. Relationships between variables were investigated using the "person product-moment" correlation coefficient, to test the existence of small (from 0.10 to 0.29), medium (from 0.3 to 0.49), or large (from 0.5 to 1) correlations [55]. A final investigation of the relationship among variables, using a hierarchical sequential linear regression model (with enter methodology), was implemented to test the hypotheses, defining the predictors of exploration, exploitation and ambidexterity, useful to establish the impacts of control variables, input variables and moderators, respectively. In particular, the adjusted  $R^2$  was examined in order to control the explanatory power of each model [56]. Three different models were developed, defining the influence of the different variables (control, independent and moderator variables), as suggested by other authors [3,57]:

- Model 1: composed only of the control variables (size of the ward, age of the professionals in the ward, ownership of the hospital, research orientation of the ward and hospital strategy);
- Model 2: composed of Model 1, with the inclusion of the independent variables (closing/opening leadership, POS, OC and ED);
- Model 3: composed of Model 1 and Model 2, with the inclusion of the moderator variables.

All statistical analyses were performed using the Statistical Package for Social Science of IBM SPSS (Version 22).

## 4. Results

### 4.1. The sample under investigation

The present study involved 80 healthcare professionals from different Italian hospital wards, mostly in Northern Italy (96%).

The sample was composed predominately of males (64%), with an average age of 53 years (range: 32–65 years), and individuals had been working in the wards for 15 years. Respondents had been covering, on average, the organisational role for 15 years. A total of 8.8% of the sample worked in administrative or managerial departments (thus justifying the wide range of sample age) and 91.2% worked in clinical departments. Professionals were affiliated to the wards of public (91%) and private (9%) hospitals, most of them with a defined research orientation (82% versus 18%). Furthermore, 40% of the wards presented a clinical excellence strategy, followed by profit maximisation (33%) and technological orientation (27%).

### 4.2. Reliability of the variables

Table 2 depicts the reliability of the scales used to test hypotheses. Some items related to ED and exploitation were deleted since their component value was below the defined threshold of 0.3. All scales related to both dependent and independent variables under assessment were accepted since they presented a value of Cronbach's alpha largely above 0.7.

### 4.3. Hypothesis testing

Table 3 depicts that ambidexterity was influenced by opening ( $p < 0.001$ ) and closing leadership ( $p < 0.001$ ), POS ( $p < 0.001$ ), OC ( $p < 0.001$ ) and ED ( $p < 0.05$ ). The same trend emerged considering exploitation and exploration. No relationships were reported con-

**Table 2**  
Resume of variables.

Construct	N	Number of items in the original scale	Number of validated items	Explained variance (%)	Cronbach's alpha
Opening Leadership	78	7	7	66.588	0.813
Closing Leadership	80	7	7	71.732	0.933
Organisational Support	80	8	8	78.763	0.961
Organisational Creativity	80	13	13	73.461	0.968
Environmental Dynamism	80	17	14	63.221	0.836
Exploration	80	9	8	80.405	0.784
Exploitation	80	12	12	76.264	0.874

**Table 3**  
Correlations among variables.

	1	2	3	4	5	6	7	8	9	10	11	12
(1) Ambidexterity	1											
(2) Exploration	0.849**	1										
(3) Exploitation	0.870**	0.499**	1									
(4) Opening leadership	0.497**	0.463**	0.396**	1								
(5) Closing leadership	0.389**	0.138	0.537**	0.190	1							
(6) POS	0.478**	0.397**	0.454**	0.457**	0.500**	1						
(7) Org. creativity	0.521**	0.418**	0.478**	0.191	0.013	0.305**	1					
(8) Env. Dynamism	0.309**	0.232*	0.295**	-0.004	0.160	0.146	0.275*	1				
(9) Opening Leadership x Env. Dynamism	0.079	0.112	0.068	0.083	-0.003	0.118	-0.004	0.099	1			
(10) Closing Leadership x Env. Dynamism	-0.021	0.053	-0.055	0.034	-0.039	0.056	-0.284*	-0.039	0.373**	1		
(11) POS x Env. Dynamism	0.055	0.070	0.058	0.128	0.062	0.114	-0.160	0.012	0.496**	0.725**	1	
(12) Org. Creativity x Env. Dynamism	-0.175	-0.078	-0.194	0.041	-0.286*	-0.153	0.076	-0.339**	0.241*	0.205	0.179	1

Significance levels: \* $p < 0.05$ ; \*\* $p < 0.001$ .

cerning the moderator effect of ED on the investigated dependent variables.

With regard to the independent variables, POS, opening and closing leadership, and OC were related (showing a  $p < 0.05$ ). Furthermore, a significant correlation was reported between ED and OC, demonstrating that in case of increase in the dynamism level, clinicians are more stimulated to propose creative and innovative ideas.

After testing the correlation among variables, a regression analysis was conducted to test hypotheses (Table 4), considering the three models developed for ambidexterity, exploration and exploitation.

Results (Model 2) showed that both opening ( $\beta = 0.372$ ;  $p < 0.001$ ) and closing ( $\beta = 0.280$ ;  $p < 0.01$ ) leadership, as well as OC ( $\beta = 0.412$ ;  $p < 0.001$ ) were required to achieve ambidextrous behaviours (adjusted  $R^2 = 0.535$ ). Opening and closing leadership were confirmed as necessary behaviours to pursue ambidexterity, thus also integrating OC as a fundamental component to create innovation. Model 3 confirmed the relevance of the above independent variables, and no significant effect emerged of ED as a moderator.

With regard to the ancillary models, it emerged (Model 2) that opening leadership ( $\beta = 0.375$ ;  $p < 0.01$ ), OC ( $\beta = 0.274$ ;  $p < 0.05$ ) and ED ( $\beta = 0.219$ ;  $p < 0.05$ ) are antecedents of exploration (adjusted  $R^2 = 0.349$ ). Focusing on the ED (in terms both of dependent variable and moderator, as shown in Model 3), a positive relationship emerged with regard to exploration, demonstrating that a turbulent context could motivate clinicians in proposing new solutions and searching for innovation outside of hospital.

Exploitation (Model 2) was well explained by closing leadership ( $\beta = 0.523$ ;  $p < 0.001$ ) and OC ( $\beta = 0.429$ ;  $p < 0.001$ ), reaching an adjusted  $R^2$  equal to 0.469. A closed leader is useful to better exploit internal resources, and for being efficient in ward activities. At the same time, being creative is not only necessary in exploring new knowledge, but also in administering this new information in successful ways.

No significant effects of ED were reported, in terms of moderator, with regard to ambidexterity, exploration and exploitation. The same trend emerged considering the control variables (Model 1).

## 5. Discussion

The results aimed to show possible determinants of ambidexterity, being something that literature has not yet completely investigated within healthcare settings.

The following considerations emerged:

- Size, ownership, research orientation and hospital strategy do not affect contextual ambidexterity in the healthcare sector. This means that ambidexterity is the result of social and organisational mechanisms. This is in contrast with the practice in other settings, where career experiences and knowledge of individuals can enable ambidextrous approaches [48,58].
- The coexistence of two different styles of leadership may be required to reach ambidextrous behaviours, consistent with previous literature [17]. A good clinician, in order to be innovative, should not only monitor and control professionals but also promote ideas and risk-taking. Healthcare managers should be active, pursuing change adaptation, and being promoters of innovative processes [59], able to switch between opening and closing attitudes.
- Despite literature [43] reports that POS should positively affect the achievement of innovation, in the present study it is not conducive to ambidexterity. This confirms that hospitals are decoupled organisations where managers are not able to mandate change. In fact, clinicians prefer working autonomously and do not share their own abilities, creating a distance between the hospital direction and the ward [60]. Despite this, POS plays a major role in enhancing the creativity of employees, where they will be motivated to upgrade the organisation's performance and productivity [27].
- OC positively affects all the dependent variables, and it is related to the leadership behaviour previously described because clinicians are a source of innovative ideas and solutions. They understand the complexity of the healthcare sector, allowing professionals to spread successful practices [61]. The results demonstrate that creative ideas are a necessary condition for innovation, in terms of exploring new sectors, as well as better exploiting existing activities. New ideas are not only important

**Table 4**  
Hierarchical regression for dependent variables.

Dependent variable: Ambidexterity	Model 1	Model 2	Model 3
<b>Control variables</b>			
• Ward dimension	0.087	0.121	0.117
• Average age of people working in the ward	−0.028	0.061	0.076
• Hospital ownership (public or private)	0.013	0.081	0.105
• Research orientation	0.033	−0.006	−0.003
• Hospital strategy	−0.064	0.061	0.036
<b>Independent variables</b>			
• Opening Leadership		0.372***	0.389***
• Closing Leadership		0.280**	0.288**
• Organisational Support		0.031	−0.029
• Organisational Creativity		0.412***	0.499***
• Environmental Dynamism		0.177*	0.094
<b>Moderators</b>			
• Opening Leadership x Env. Dynamism			0.052
• Closing Leadership x Env. Dynamism			0.191
• Organisational Support x Env. Dynamism			−0.086
• Organisational Creativity x Env. Dynamism			−0.126 <sup>ψ</sup>
R <sup>2</sup>	0.012	0.596	0.616
<b>Adjusted R<sup>2</sup></b>	−0.057	<b>0.535</b>	<b>0.529</b>
F value	0.174	9.731***	9.741***
Δ R <sup>2</sup>	0.012	<b>0.584</b>	0.020
F(ΔR <sup>2</sup> )	0.174	19.066***	1.160
Dependent variable: Exploration			
<b>Control variables</b>			
• Ward dimension	0.066	0.080	0.081
• Average age of people working in the ward	0.072	0.94	0.094
• Hospital ownership (public or private)	0.018	0.89	0.089
• Research orientation	0.057	−0.008	−0.007
• Hospital strategy	0.009	0.132	0.133
<b>Independent variables</b>			
• Opening Leadership		0.375**	0.375**
• Closing Leadership		—	—
• Organisational Support		0.125	0.128
• Organisational Creativity		0.274**	0.270*
• Environmental Dynamism		0.219*	0.224 <sup>ψ</sup>
<b>Moderators</b>			
• Opening Leadership x Env. Dynamism			0.001
• Closing Leadership x Env. Dynamism			—
• Organisational Support x Env. Dynamism			−0.010
• Organisational Creativity x Env. Dynamism			0.007
R <sup>2</sup>	0.015	0.426	0.426
<b>Adjusted R<sup>2</sup></b>	−0.054	<b>0.349</b>	<b>0.318</b>
F value	0.218	5.522***	3.957***
Δ R <sup>2</sup>	0.015	<b>0.411</b>	0.000
F(ΔR <sup>2</sup> )	0.218	11.984***	0.364
Dependent variable: Exploitation			
<b>Control variables</b>			
• Ward dimension	0.083	0.139	0.128
• Average age of people working in the ward	−0.119	0.031	0.038
• Hospital ownership (public or private)	0.004	0.027	0.037
• Research orientation	−0.001	0.051	0.040
• Hospital strategy	−0.118	−0.040	−0.053
<b>Independent variables</b>			
• Opening Leadership		—	—
• Closing Leadership		0.523***	0.506***
• Organisational Support		0.025	−0.012
• Organisational Creativity		0.459***	0.529***
• Environmental Dynamism		0.065	−0.014
<b>Moderators</b>			
• Opening Leadership x Env. Dynamism			—
• Closing Leadership x Env. Dynamism			0.066
• Organisational Support x Env. Dynamism			0.067
• Organisational Creativity x Env. Dynamism			−0.132
R <sup>2</sup>	0.030	0.530	0.546
<b>Adjusted R<sup>2</sup></b>	−0.036	<b>0.469</b>	<b>0.463</b>
F value	0.458	8.646***	6.614***
Δ R <sup>2</sup>	0.030	<b>0.500</b>	0.016
F(ΔR <sup>2</sup> )	0.458	18.337***	0.878

Significance levels: \*\*\* p < 0.001; \*\* p < 0.01; \* p < 0.05; <sup>ψ</sup> p < 0.1.

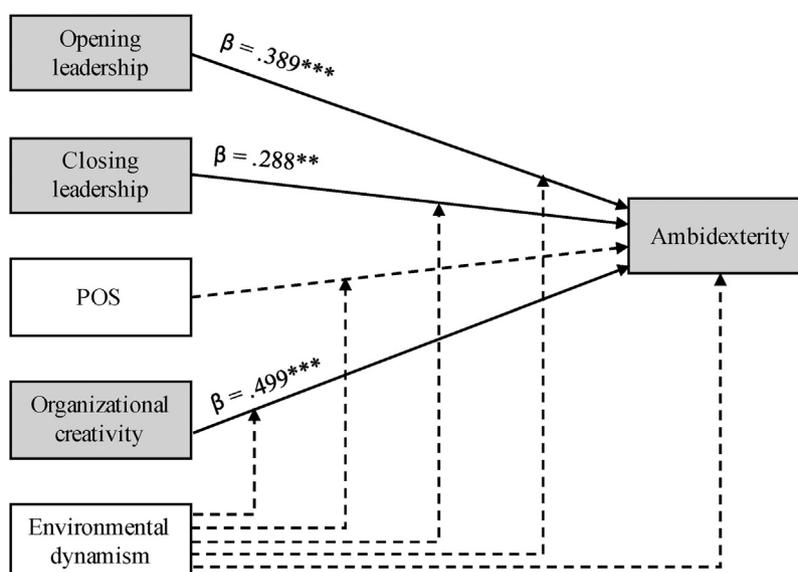


Fig. 1. Ambidexterity framework with verified hypotheses.

for acquiring new knowledge, but also to better use these innovative solutions in the ward, and to share knowledge among the working team.

- ED does not act as moderator. Hospitals prefer to maintain internal stability and are more resilient to change [14]. The exploration found a positive relationship with ED: turbulent context could motivate clinicians in proposing new solutions and searching for innovation, outside the organisation.

Fig. 1 shows the main findings after testing the hypotheses.

The results could also impact healthcare sector managerial practices.

One of the most relevant challenges in healthcare settings is resistance to change. A clinician, acting as leader, should promote possible changes as a result of participating in leadership programmes, thus overcoming resilience [60] and avoiding the block of investment. As the use of multiple control systems (in terms of opening and closing leadership) may require considerable managerial attention, management should prioritise where to focus their attention and resources [62,63].

In addition, a good leader should motivate clinicians toward the development of a creative and open mind, revealing the significance of OC, a factor related to leadership. A stronger relationship among different medical wards could be created in order to have a wider vision and develop interdepartmental creativity.

With regard to POS, clinicians should be supported by top management departments to foster innovation. They should create coordination mechanisms to incentivise communication between managerial and clinical departments [64], as also advocated by clinical governance principles [65], or promote and support training and educational activities, allowing clinicians to participate in learning programmes [22]. Clinicians should conceive the turbulence in the environment as a trigger point to innovate, and not as a way to create static structures [14]. ED may encourage clinicians to establish innovation fields with diverse perspectives.

Despite the relevance of the results, the present study has several limitations that should be considered in the interpretation of the findings. Unlike other studies [45,66], the analysis used exploration, exploitation and ambidexterity, only as dependent variables, without considering whether and how ambidexterity could effectively affect performance within the healthcare setting, thus presenting a static picture of the analysed context.

The size of the sample, even if significant for the response rate gained, could be considered limited in relation to the reduced geographic representation, relegated to northern Italy.

In addition, the collection of data only from one respondent per ward could represent a drawback. This last limitation was partially overcome by testing the common method variance, to ensure that the data had no major problems with response bias.

Since exploration and exploitation have been measured with scales based on perceptions, further research is suggested to identify those measures that express a greater possibility and ability to capture these behaviours.

## 6. Conclusions

This study offers original insights to further the ongoing debate about how hospitals might innovate care delivery, meeting the increasing societal pressure for high-quality and safe services that are also efficient. In other sectors, the paradigm of ambidextrous organisations has emerged as relevant reference to achieve conflictual goals – as quality, safety and efficiency – through the capability to enable both explorative and exploitative behaviours. Despite the relevance of the topic, very limited evidence has been gathered so far in the healthcare setting.

This study – to best of our knowledge – is the first to gather empirical evidence about what drives ambidexterity in hospital wards. In this view, our findings may contribute to offer solutions to hospital wards, leading to the determination of an efficient leadership style, together with a creative and open mind, useful to foster innovation and present ambidexterity. In particular, hospital wards could appoint head physicians who balance open and close leader behaviours, as well as stimulating settings for organizational creativity, by facilitating the creation of new ties (hiring professionals from outside, incentivising participation to conferences, or international projects).

## Funding

None.

## Declaration of Competing Interest

None.

## Acknowledgements

The authors would like to thank all the hospital professionals who have been involved in this study for their valuable contribution by filling in the questionnaire and by providing relevant insights on “ambidexterity” in hospital wards. Additionally, the authors would like to thank Mrs Antonella Maffi and Mrs Marta Sali for the support provided with data management and data analysis.

## References

- [1] Radaelli G, Lettieri E, Masella C, Merlino L, Strada A, Tringali M. Implementation of Eunetha core model® in Lombardia: the VTS framework. *International Journal of Technology Assessment in Health Care* 2014;30(01):105–12.
- [2] Gastaldi L, Appio FP, Corso M, Pistorio A. Managing the exploration-exploitation paradox in healthcare: three complementary paths to leverage on the digital transformation. *Business Process Management Journal* 2018;24(5):1200–34.
- [3] Pinzone M, Lettieri E, Masella C. Proactive environmental strategies in healthcare organizations: drivers and barriers in Italy. *Journal of Business Ethics* 2014;1–15.
- [4] Gilmartin M, D’Aunno T. Leadership research in healthcare: a review and a roadmap. *Academy of Management Annals* 2007;1:387–438.
- [5] Drummond M, Shemilt I, Vale L, on behalf of the Campbell and Cochrane Economic Methods Group. Should the Cochrane Collaboration be producing reviews of efficiency? *Cochrane Database of Systematic Reviews* 2013;10:ED000071.
- [6] Lavie D, Stettner U, Tushman ML. Exploration and exploitation within and across organizations. *Academy of Management Annals* 2010;4(1):109–53.
- [7] Malik A, Boyle B, Mitchell R. Contextual ambidexterity and innovation in healthcare in India: the role of HRM. *Personnel Review* 2017;46(7):1358–80.
- [8] March JG. Exploration and exploitation in organizational learning. *Organization Science* 1991;2(1):71–87.
- [9] Martini A, Gastaldi L, Corso M, Magnusson M, Laugen BT. Continuously innovating the study of continuous innovation: from actionable knowledge to universal theory in continuous innovation research. *International Journal of Technology Management* 2012;60:157–78.
- [10] Turner N, Swart J, Maylor H. Mechanisms for managing ambidexterity: a review and research agenda. *International Journal of Management Reviews* 2013;15:317–32.
- [11] Gibson CB, Birkinshaw J. The antecedents, consequences and mediating role of organizational ambidexterity. *Academy of Management Journal* 2004;47:209–26.
- [12] Gastaldi L, Corso M. Smart healthcare digitalization: using ICT to effectively balance exploration and exploitation within hospitals. *International Journal of Engineering Business Management* 2012;4:1–13. Special Issue on Digital and Mobile Economy.
- [13] Koster F, van Bree Gina. How managers evoke ambidexterity and collaboration: a qualitative study in a Dutch Hospital. *International Journal of Innovation and Technology Management* 2018;15(5).
- [14] Mura M, Radaelli G, Spiller N, Lettieri E, Longo M. The effect of social capital on exploration and exploitation. *Journal of Intellectual Capital* 2014;15:430–50.
- [15] Chemers M. An integrative theory of leadership. Lawrence Erlbaum Associates; 1997.
- [16] Manz CC, Bastien DT, Hostager TJ, Shapiro GL. Leadership and innovation: a longitudinal process view. In: Van de Ven AH, Angle HL, Poole MS, editors. *Research on the management of innovation: the Minnesota studies*. New York: Harper and Row; 1989. p. 613–36.
- [17] Rosing K, Frese M, Bausch A. Explaining the heterogeneity of the leadership-innovation relationship: ambidextrous leadership. *The Leadership Quarterly* 2011;22:956–74.
- [18] Rosing K, Rosenbusch N, Frese M. Ambidextrous leadership in the innovation process. In: Gerybadze A, Hommel U, Reiners HW, Thomaschewski D, editors. *Innovation and international corporate growth*. Berlin: Springer; 2010. p. 191–204.
- [19] Sumathi GN, Thenmozhi M, Kamalanabhan TJ. Healthcare professionals’ perspective of support from public health department: a study in the primary health centers of Tamil Nadu. *Indian Journal of Public Health* 2014;58:230.
- [20] Acker GM. The effect of organizational conditions (role conflict, role ambiguity, opportunities for professional development, and social support) on job satisfaction and intention to leave among social workers in mental healthcare. *Community Mental Health Journal* 2004;40:65–73.
- [21] Pinsky WP. The roles of research in an academic medical center. *Ochsner Journal* 2000;2(Oct (4)):201–2.
- [22] Gumus G, Borkowski N, Deckard CJ, Martel KJ. Healthcare managers’ perceptions of professional development and organizational support. *Journal of Health and Human Services Administration* 2011;34(1):42.
- [23] Sampietro-Colom L, Lach K, Pasternack I, Wasserfallen JB, Cicchetti A, Marchetti M, Kidholm K, Arentz-Hansen H, Rosenmüller M, Wild C, Kahveci R, Ulst M. Guiding principles for good practices in hospital-based health technology assessment units. *International Journal of Technology Assessment in Health Care* 2015;31(6):457–65.
- [24] McGregor M. Impact of TAU reports. Technology Assessment Unit (TAU) of the McGill University Health Centre (MUHC): McGill University Health Centre; 2008.
- [25] Woodman RW, Sawyer JE, Griffin RW. Toward a theory of organizational creativity. *The Academy of Management Review* 1993;18:293–321.
- [26] Zhou J, George JM. When job dissatisfaction leads to creativity: encouraging the expression of voice. *Academy of Management Journal* 2001;44:682–96.
- [27] Hibrabim HI, Isa A, Shahbudin AS. Organizational support and creativity: the role of developmental experiences as a moderator. *Procedia Economics and Finance* 2016;35:509–14.
- [28] Strating MM, Nieboer AP. Norms for creativity and implementation in healthcare teams: testing the group innovation inventory. *International Journal for Quality in Healthcare* 2010;22:275–82.
- [29] Baker T, Nelson RE. Creating something from nothing: resource construction through entrepreneurial bricolage. *Administrative Science Quarterly* 2005;50(3):329–66.
- [30] Garud R, Karnøe P. Bricolage versus breakthrough: distributed and embedded agency in technology entrepreneurship. *Research Policy* 2003;32(2):277–300.
- [31] Birkinshaw J, Gibson C. Building ambidexterity into an organization. *Sloan Management Review* 2004;45(4):47–55.
- [32] Dess GG, Beard DW. Dimensions of organizational task environments. *Administrative Science Quarterly* 1984;29:52–73.
- [33] Jansen JJ, Volberda HW, Van Den Bosch FA. Exploratory innovation, exploitative innovation, and ambidexterity: the impact of environmental and organizational antecedents. *Schmalenbach Business Review* 2005;57:351–63.
- [34] Posen HE, Levinthal DA. Chasing a moving target: exploitation and exploration in dynamic environments. *Management Science* 2012;59(3):587–601.
- [35] Duncan RB. Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly* 1972;17:313–27.
- [36] Yli-Renko H, Autio E, Sapienza HJ. Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic Management Journal* 2001;22(6/7):587–613.
- [37] Ahuja G. The duality of collaboration: inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal* 2000;21(3):317–43, 2000.
- [38] McEvily B, Marcus A. Embedded ties and the acquisition of competitive capabilities. *Strategic Management Journal* 2005;26(11):1033–55, 2005.
- [39] Waldman DA, Ramirez GG, House RJ, Puranam P. Does leadership matter? CEO leadership attributes and profitability under conditions of perceived environmental uncertainty. *Academy of Management Journal* 2001;44(1):134–43.
- [40] Kellogg KC. Operating room: relational spaces and microinstitutional change in surgery. *American Journal of Sociology* 2009;115(3):657–711, 2009.
- [41] Kellogg KC, Breen E, Ferzoco SJ, Zinner MJ, Ashley SW. Resistance to change in surgical residency: an ethnographic study of work hours reform. *Journal of the American College of Surgeons* 2006;202(4):630–6.
- [42] Volberda H, Van Bruggen G. Environmental turbulence: a look into its dimensionality. In: ERIM (Electronic) books and chapters; 1997.
- [43] Eisenberger R, Huntington R, Hutchinson S, Sowa D. Perceived organizational support. *Journal of Applied Psychology* 1986;71(3):500–7.
- [44] Wulf T, Stubner S, Blarr H, HHL Working Papers Ambidexterity and the concept of fit in strategic management—which better predicts success. Leipzig Graduate School of Management; 2010.
- [45] Lubatkin MH, Simsek Z, Yan L, Veiga JF. Ambidexterity and performance in small- to medium-sized firms: the pivotal role of top management team behavioral integration. *Journal of Management* 2006;32:646–72.
- [46] West MA, Borrill CS, Dawson JF, Brodbeck F, Shapiro DA, Haward B. Leadership clarity and team innovation in healthcare. *The Leadership Quarterly* 2003;14(4):393–410.
- [47] Bengtsson L, Lakemond N, Lazzarotti V, Manzini R, Pellegrini L, Tell F. Open to a select few? Matching partners and knowledge content for open innovation performance. *Creativity and Innovation Management* 2015;24(1):72–86.
- [48] Gupta AK, Smith KG, Shalley CE. The interplay between exploration and exploitation. *Academy of Management Journal* 2006;49:693–706.
- [49] Autio E, Sapienza HJ, Almeida JG. Effects of age at entry, knowledge intensity, and imitability on international growth. *Academy of Management Journal* 2000;43(5):909–24.
- [50] Teplensky JD, Pauly MV, Kimberly JR, Hillman AL, Schwartz JS. Hospital adoption of medical technology: an empirical test of alternative models. *Health Services Research* 1995;30(3):437–65.
- [51] Price JL, Mueller CW. Handbook of organizational measurement. Pitman Publishing; 1986.
- [52] Nunnally JC, Bernstein IH, Berge JMT. Psychometric theory, Vol. 226. New York (NY): McGraw-Hill; 1967.
- [53] Reis HT, Gosling SD. Social psychological methods outside the laboratory. In: Fiske ST, Gilbert DT, Lindzey G, editors. *Handbook of social psychology*, 5th ed. New York (NY): McGraw-Hill; 2010. p. 82–114.
- [54] Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology* 2003;88:879.
- [55] Cohen J. Statistical power analysis for the behavioral sciences, 2nd ed. Erlbaum; 1988.
- [56] Tabachnick BG, Fidell LS. Using multivariate statistics, 5th ed; 2007.
- [57] Miedaner M, Kuntz L, Enke C, Roth B, Nitzsche A. Exploring the differential impact of individual and organizational factors on organizational commitment of physicians and nurses. *BMC Health Services Research* 2018;18:180.

- [58] Taylor A, Greve HR. Superman or the fantastic four? Knowledge combination and experience in innovative teams. *Academy of Management Journal* 2006.
- [59] Tran V, Voyer B. Fostering innovation: an organizational perspective. *British Journal of Healthcare Management* 2015;21(3):141–5.
- [60] Kumar RD. Leadership in healthcare. *Anaesthesia and Intensive Care Medicine* 2013;14:39–41.
- [61] House RJ. A path goal theory of leader effectiveness. In: *Administrative Science Quarterly*; 1971. p. 321–39.
- [62] Marginson DE. Management control systems and their effects on strategy formation at middle management levels: evidence from a UK organization. *Strategic Management Journal* 2002;23:1019–31.
- [63] Widener SK. An empirical analysis of the levers of control framework. *Accounting, Organizations and Society* 2007;32:757–88.
- [64] Oborn E, Barrett M, Prince K, Racko G. Balancing exploration and exploitation in transferring research into practice: a comparison of five knowledge translation entity archetypes. *Implementation Sciences* 2013;8:104.
- [65] Scally G, Donaldson L. Clinical governance and the drive for quality improvement in the new NHS in England. *British Medical Journal* 1998;317:61–5.
- [66] He Z-L, Wong PK. Exploration vs. exploitation: an empirical test of the ambidexterity hypothesis. *Organization Science* 2004;15:481–94.