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Multi-Method Approach to Exploring Social–Ecological Dimensions in a Mediterranean Suburban Beach Setting

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Research related to social–ecological systems may be enhanced through multi-method approaches to collecting interdisciplinary data and using combinations of analytical tools. In this article we combine different types of data (interval, ordinal, nominal, spatial), methods (participant observation, survey instrument), and analytical tools (IBM Statistical Package for the Social Sciences [SPSS] and Geographic Information Systems [GIS]) to identify management relevant linkages across social and ecological dimensions in a Mediterranean suburban beach setting. In particular, we demonstrate the central role of quantitative perception data for identifying pragmatic environmental management measures in coastal recreation scenarios.

Keywords case study approach, coastal tourism, GIS, Mediterranean, multi-method assessments, perceptions

Introduction

It is well established that socioeconomic, cultural, and governance factors influence how people perceive and interact with natural resources (Perry and Ommer 2010; Pollnac et al. 2010; Pollnac, Crawford, and Gorospe 2001; Pomeroy and Douvere 2008). Significant progress has been made in exploring the connection between social and ecological realms, particularly in fields such as anthropology, ethnobiology, and ecological modeling. Yet, despite several decades of research, our ability to apply this knowledge to the effective management of environmental resources is limited (Liu 2001; Pretty 2011).

Research related to social–ecological systems (SES) may be enhanced through multi-method approaches to collecting interdisciplinary data, both objective (e.g., spatial dimensions, demographics, biological variables) and subjective (e.g., values, beliefs

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and perceptions), and using creative combinations of methods and analytical tools. A growing number of such studies exist in the coastal and marine management literature (e.g., Aswani 2011; Christie 2005; Cinner et al. 2009; Diedrich, Balaguer, and Tintoré 2011; Pollnac, Crawford, and Gorospe 2001). However, the tendency is still toward studying social and ecological systems separately (Christie 2011; Perry and Ommer 2010).

Relationships between the ecological and social realms can be unpredictable, consisting of complex webs of dependent and independent variables, which vary considerably in space, time, and cultural context (Liu 2001; Perry and Ommer 2010; Pollnac, Crawford, and Gorospe 2001; Pollnac et al. 2010; Pretty 2011). Perception data can be useful for exploring the connection between humans and the natural environment because they can be integrated and correlated with data from other disciplines across space and time. Geographic Information Systems (GIS) in particular is an effective, often underutilized tool for integrating different data types (Aswani 2011; Diedrich et al. 2011; Liu 2001).

Comparing what people perceive (i.e., the subjective realm) with what is actually occurring in environmental management scenarios (i.e., the objective realm) can help identify potential discords and, hence, shape environmentally significant behavior. For example, identifying dissonance between technical and perceptual measures of environmental risk has been cited as important for developing related management actions (Hughey et al. 2004). In the urban planning literature, Marans (2003) argues that a better understanding of environmental quality requires studies of the interrelationships between objective environmental measures and society's responses to them. The author goes on to highlight the important point that policy makers often want to enhance satisfaction and it is important to link this with associated objective conditions. Also related to urban planning, Steinwender, Gundacker, and Wittmann (2008) associates objective water quality indicators with subjective assessments of visitors to waterfronts and suggests that such assessments could improve the identification of problems, including the development and implementation of amelioration strategies.

In addition to providing quantitative data for the subjective component of the SES model, on the applied level, perceptions can help to identify management-relevant linkages between the social and ecological realms that may not be intuitive or immediately obvious. In this article we demonstrate this role of perception data using a case study of the Bay (*Cala*) Xinxell, a suburban beach on the Balearic Islands of Spain in the Western Mediterranean. Based on the simple assumption that more people and boats in a limited space such as the *Cala* will increase potential ecological and social impacts, we address the following applied research questions:

- Who are the different users of the beach space and how are they affected by increases in the number of people and boats in the *Cala*? Are there differences in perceived effects among users?
- Is there a relationship between the actual number of people and boats in the *Cala* and the perceptions of the users?
- How does the number of people and boats affect the well-being of users and why? Are different users affected in different ways?
- What are the levels of satisfaction of the users and their motivations for visiting the beach? What affects satisfaction?
- What, if any, are the management relevant connections between the social and natural environment of the beach?

Tourism and Recreation Context

A literature review related to tourism and recreation, which simply provides a context for the analysis, is outside the scope of this article. However, a few key points warrant brief consideration. Tourism and recreation in natural areas generally require a tradeoff between ecological and social objectives. Thus, it has been argued that understanding the perception of users is an important element of improving management of recreational ecosystem services (e.g., Petrosillo et al. 2007; Priskin 2003). There is often a discord between the priorities of beach managers and needs that are identified through research (Ariza, Jiménez, and Sardá 2008; James 2000). Beaches in the Mediterranean, and in many popular tourism destinations tend to be seen as commodities for leisure and coastal protection (Ariza, Jiménez, and Sardá 2008). Due to this, management often prioritizes social over ecological objectives. In this context (and in many other scenarios) it is important to identify socially relevant ecological impacts, which can then be used to develop pragmatic management measures that respond to both social and ecological goals.

Methods

Research Site Description

The current study was carried out in the *Cala* Xinxell of Mallorca in of the Balearic Islands. Figure 1 shows an aerial photograph of the study site that includes a beach (zone A), a swimming area where boats are not permitted (B), and an anchoring zone used for recreational boating (C).

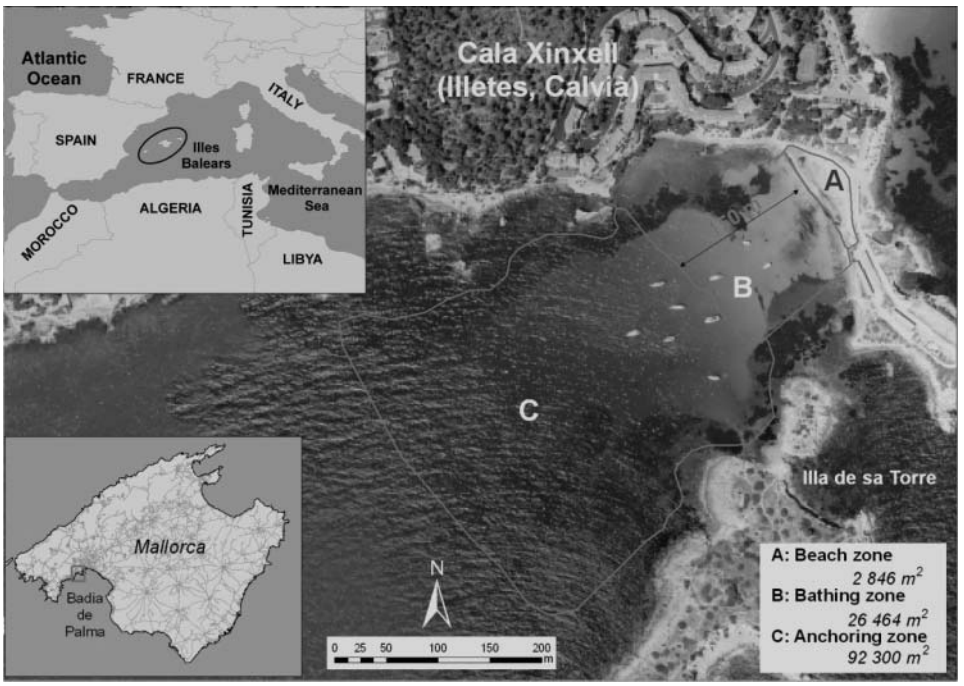

Figure 1. Study Site: *Cala* (Bay) Xinxell (adapted from Diedrich, Balaguer, and Tintoré 2011).

Data and Sources

The data analyzed in the results section pertain to the beach zone A (Figure 1). Data were also collected in zone C, the anchoring zone, using comparative methods (see Diedrich, Balaguer, and Tintoré 2011). The studies were conducted at the same time with a view to developing an integrated spatial management plan for the *Cala*. The results of both studies have been taken into consideration in the management recommendations presented in the discussion section.

The data in this analysis are derived from three sources: (1) participant observation; (2) aerial photographs; and (3) a survey instrument. The survey instrument and participant observation were conducted during fieldwork in the high season for tourism in the summer of 2008 (June 21–September 3). Table 1 shows the data categories and types, and the methods used to obtain them. The categories correspond with the analysis in the results section.

The survey was self-administered by the beach users, took about 5 minutes to complete, and was printed in five languages. Surveys were distributed on two days of every week, alternating between days during the week and weekend days. The aim of the survey was to obtain a representative sample of users *across* the sample period as opposed to obtaining statistically viable samples on a daily basis. Surveyors zigzagged along the beach distributing one survey per family or group during the peak hours of beach usage. Randomness was maximized by approaching every nth group along the beach in order to achieve, on average, a daily sample of 40% of adult users. The actual number of beach users and recreational boaters (which were counted from shore) was also recorded periodically.

Four hundred and eighty-nine surveys were obtained over a period of 22 days with a response rate of 76%. The analysis was conducted using SPSS for the statistical data and ArcGIS for the spatial data.

Results

Use Levels and Crowding

The mean number of beach users per day was 155 (min. 46–max. 225). Taking into account the area of zone A (Figure 1), this implies that, when the beach is least crowded, on average and assuming users are uniformly distributed (this general pattern was observed in the periodic counts), there is approximately 8 m between users (calculated as the radius of a circle around them) and when it is most crowded there is about 3 m between users. The mean number of boats using the bay was 39 (min. 12–max. 82). Minimum and maximum use levels correspond with a distance of approximately 88 m and 33 m between boats, respectively. Logically, in both cases, use levels tended to be higher at the weekend than on weekdays, although a more significant fluctuation was observed in the case of boats.

User Characteristics

The demographic data suggest that the most common visitor to the beach is a resident of Mallorca (69%) as opposed to a tourist, of Spanish origin (94%), between 21–40 years old (58%, not counting children), and a person who visits the beach habitually. The data showed no obvious demographic difference between weekend and weekday visitors. Where relevant, tests have been conducted on the data in the following subsections to detect

Table 1
Data sources and categories

Source	Category	Method	Data type
Participant observation	Use levels	Periodic counts of people on the beach and boats in the Cala.	Interval
Aerial photographs	Space available for use by people and boats	Maps obtained from SITIBSA (*Servicio de Información Territorial de les Illes Balears*), Environment and Mobility Council, Government of the Balearic Islands, 2002 (scale 1/5000). Shape files delimiting the area of the beach and Cala created using ArcGIS.	Spatial (shape)
Survey instrument	User characteristics	Demographic questions.	Nominal
	Perceptions of use levels (people and boats)	Respondents asked to react to the number of people on the beach and boats in the bay at the time of the survey using three response categories: (1) prefers fewer, (2) is content with the present number, (3) prefers more.	Ordinal
	Perceived effects of an increase in people and boats on well-being	Respondents asked how an increase in people and boats affects their general well-being on a scale of 1 (decreases a lot) to 5 (increases a lot).	Ordinal
		Follow-up open-ended question (up to three responses) about why an increase in people and boats has the perceived effect on well-being.	Nominal
	General satisfaction	Respondents asked to state their general satisfaction level on a scale of 1 (very unsatisfied) to 5 (very satisfied).	Ordinal
		Follow-up open-ended question (up to three responses) about why they perceive this level of satisfaction.	Nominal
	Motivation for coming to the beach	Open-ended question (up to three responses) about the main reason they chose to come to the Cala.	Nominal
		Open-ended question (up to three responses) about what reason, if any, would stop them from coming to the Cala.	Nominal

statistically significant differences in the responses of residents and tourists and weekend and weekday visitors. The results are reported if observed to be statistically significant.

Relationships Between Perceptions of Use Levels (People and Boats) and Actual Use Levels

Spearman's rank order correlations of the actual number of people and boats with perceptions of use (i.e., (1) prefers fewer, (2) is content with the present number, or (3) prefers more) showed a statistically significant negative correlation of -0.18 ($p = .001$, $n = 320$) for people and -0.212 ($p < .001$, $n = 440$) for boats. In both cases, a negative correlation is what one would expect (i.e., as there are more people or boats, more respondents believe the number is adequate or would prefer to see fewer).

Figures 2 and 3 show a graphic depiction of the relationship between the actual number of boats and people and the percent of responses in the three ordinal categories. Evidently, the data are not continuous as the line graphs would suggest, but this was found to be the most effective way of visualizing the proportion of the respondents on each day who wished to see more or less boats or people in comparison with those who were content with the actual number. The x axes show the average number of boats and people observed on each day.

The figures show a clearer pattern in the case of boats (Figure 2) where, once the number of boats passes from 23 to 30, the proportion of respondents who would prefer to see fewer boats remains consistently higher than those who are content or would prefer to see more. This is not the case in figure 3, where there appears to be no clear pattern between the number of people and the perceptions of the respondents. Additionally, Figure 2 shows only two days where the proportion of people content with the number of boats surpasses those who wish there were fewer as opposed to 9 days in Figure 3. This indicates that, in general, visitors of the beach are more affected by boats in the water as opposed to people on the beach.

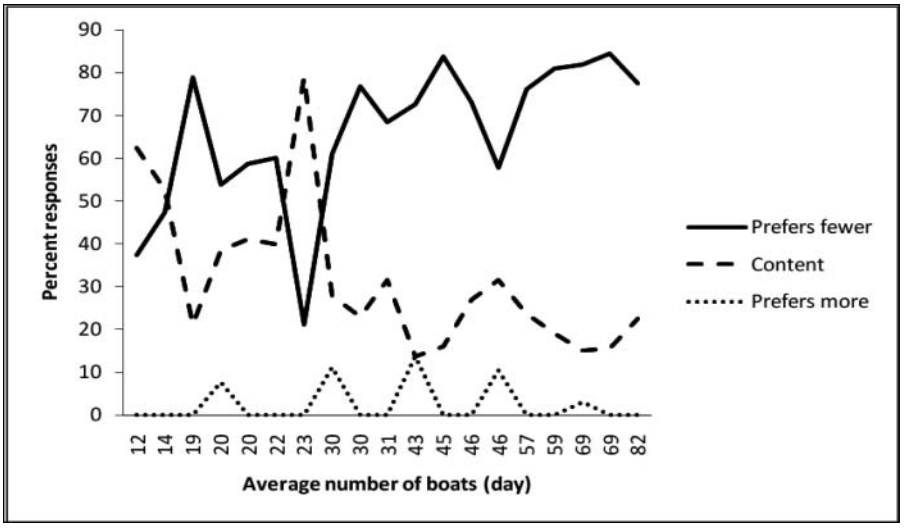

Figure 2. Relationship between perceptions and the number of boats in the water.

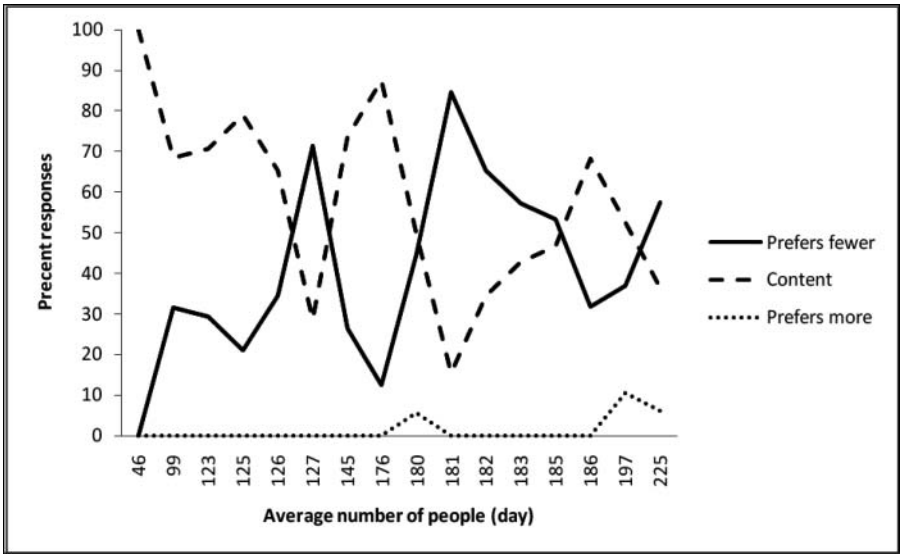

Figure 3. Relationship between perceptions and the number of people on the beach.

Perceived Effects of an Increase in People and Boats on Well-Being

The general tendency, as expected, was a perceived decrease in well-being in relation to an increase in both people and boats. Table 2 shows the proportion of responses in five ordinal categories. Responses as to why well-being was affected negatively have been categorized and are reported in Table 2 if they were stated by more than 10% of the respondents.

Mann-Whitney U tests showed significant differences between user groups with respect to the perceived impacts of an increase in boats on well-being: Resident (rank 210) and tourist (rank 250) visitors ($z = -3.1$, $p < .01$); weekday (rank 255) and weekend (rank 224) visitors ($z = -2.6$, $p < .01$); tourist weekday (rank 68) and tourist weekend (rank 56) visitors ($z = -2.1$, $p < .05$). These results indicate that residents and weekend visitors

Table 2
Perceived impacts of increases in people and boats on well-being

	People ($n = 465$)	Boats ($n = 476$)
Effect of increase on well-being	(1) Decreases a lot–42% (2) Decreases a little–40% (3) No effect–16% (4) Increases a little–1% (5) Increases a lot–1%	(1) Decreases a lot–43% (2) Decreases a little–31% (3) No effect–23% (4) Increases a little–2% (5) Increases a lot–1%
Reason for decrease in well-being	Crowding 72% Trash in sand 36% Noise 20%	Contamination 100% Affects view 54%

Percentages have been rounded so may not add up to 100.

are more sensitive to increases in the number of boats whereas the effect of the number of people on the beach does not vary among users.

General Satisfaction

Of the total sample ($n = 476$), 13% were very satisfied, 54% satisfied, 27% gave a neutral response, 5% were unsatisfied, and 1% very unsatisfied. Mann-Whitney U tests showed a significant difference between the responses of weekend (rank 226) and weekday (rank 252) visitors ($z = -2.3$; $p < .05$), indicating that weekend visitors tend to be less satisfied. The Spearman rank order correlation with actual numbers of boats and people with satisfaction were significant in the case of boats only ($r = -0.15$, $p = .002$, $n = 434$). With respect to the people who said they were satisfied ($n = 320$), the most cited reasons why related to peacefulness (40%) and the water and being clean (31%). Those who were not satisfied or gave a neutral response ($n = 185$) attributed it to the number of people (45%) or cleanliness of the beach and water (35%).

Motivations for Coming to the Beach

Of the 423 total responses, 60% stated reasons related to proximity to home and ease of access and 15% were related to cleanliness or the water and sand in general. No other coded response categories accounted for more than 10% of the sample. With respect the reasons respondents said they would stop coming to this beach ($n = 343$), 62% of the responses related to contamination of the water, 13% if access was more difficult, 13% said nothing would stop them from coming, and 10% said jellyfish. No other coded response categories accounted for more than 10% of the sample.

Discussion

The results suggest that an increase in the number of boats in the *Cala* has a more consistently negative impact on the well-being than people on the beach (Figures 2 and 3) and that this is strongly related to the perception that boats contaminate the water. The link to contamination is indicated by the fact that, in the open-ended question about why boats have a negative impact on well-being, 100% of the respondents who claimed a negative effect cited one of the reasons to be contamination. The only other category that accounted for more than 10% of the responses was impacts on the view (54%). Additional perceptions may be linked to environmental quality variables including well-being and trash in the sand, satisfaction and cleanliness of the beach and water, motivation for coming to the beach and cleanliness of the beach and the water, and contamination as a reason respondents would stop coming to the beach. In fact, the significant majority of the coded responses to the open-ended questions pertained to environmental quality variables. Other notable response categories (i.e., >10% responses) were linked to crowding (noise, peacefulness, and people on the beach), the impact of boats on the view, jellyfish, and accessibility.

Although the answers to the question about the impact of boats and people on well-being (Table 2) and the satisfaction data suggest that people generally perceive a negative effect from increases in both boats and people, the data in Figures 2 and 3 show their reactions to objective measures of crowding to be variable, particularly in the case of people (Figure 3). This apparent discord could be partly influenced by the fact that the majority of respondents said they chose to visit the beach because it was convenient, so

perhaps they are willing (or expect) to accept some crowding in exchange for this even though it may have some negative effect on well-being.

Based on the results, we recommend that management actions be prioritized in two main areas:

1. Identify, mitigate, and regulate contamination of the sand and water from boats, beach users, and other sources.
2. Regulate the number of recreational boats in the *Cala* by enforcing anchoring regulations, possibly through the installation of ecological mooring buoys.

The data of the complementary study (Diedrich, Balaguer, and Tintoré 2011) on the perceptions of recreational boaters in the adjacent marine space (zone C, Figure 1) can be used to support and add detail to these recommendations. The data from the surveys administered to recreational boaters showed that beach users did not affect their well-being. However, crowding of boats (i.e., the actual number of boats and the distance between them) was shown to have an identifiable negative impact. Combined with the more consistent negative impact of boats perceived by beach users, the results present a strong case for the implementation of priority management measures associated with boating activity. Such measures would also have positive connotations for marine habitat due to the presence of *Posidonia oceanica* in the *Cala*, an endangered and protected sea grass endemic to the Mediterranean. This habitat is negatively impacted by anchoring (e.g., Marba et al. 2002), an activity that, to date, is not effectively regulated in the *Cala*. Taking this into account, the installation of ecological mooring buoys could help support social (well-being, safety) and environmental (habitat protection) goals. In the complementary study, the spatial data (average amount of space per user and location of *Posidonia* meadows) combined with the perception data allowed us to determine the appropriate number of buoys to install.

Intuitively, in the absence of this study, managers may have considered regulating the number of visitors to the beach to be the most important management measure. Although the results do suggest a relationship between beach crowding and well-being, they identify other factors that have more significant effects, which also have clear links to environmental conservation. Hence, the study has allowed us to identify priority management measures which maximize well-being while also addressing environmental quality and habitat protection needs. Invariably, future research would lead to the identification of more socially and environmentally relevant issues and, ideally, additional management actions. The integration of economic variables using methods such as willingness to pay studies could also increase the applicability of the results. Aside from periodic measurements of water quality for public health purposes there were no additional data available to inform management of the *Cala* at the time of this study. As indicated in the recommendations, actual (not just perceived) contamination levels and sources should be identified and integrated into the SES model and associated management measures. The recent implementation of the European Water Framework Directive will increase the availability of such data.

Evidently, comparable analysis with additional sites at different spatial and temporal scales is needed to gain a deeper understanding of this complex relationship. Although the spatial data were not used to determine acceptable levels of beach use in this study (because crowding of the beach was not determined as a priority social issue), their applicability to establishing management measures is evident in the case of boats in the adjacent marine space (Diedrich, Balaguer, and Tintoré 2011). GIS is a valuable tool for integrating interdisciplinary data and for visualizing complex multiple-use scenarios. Zoning is an effective approach to balancing social and environmental objectives in coastal and marine recreational space (Agardy 1993). Additional, comparative research in neighboring coastal

and marine zones could contribute to a comprehensive zoning plan for the whole Bay of Palma where there are numerous activities related to tourism, recreation, transport, and fishing.

Finally, a brief reflection on the frequently contested value of case studies is warranted. The variability of the relationship between social and ecological variables can be observed even with extensive data sets collected on large scales, which means that detailed knowledge of the local context is important to interpret the results of such studies (Christie 2011; Pollnac et al. 2010). This calls for a systems or framework approach to data collection, management, analysis, and integration (Liu 2001; Pickett, Burch Jr., and Grove 1999). Replicable methods can be scaled up and adapted to different contexts by systematically building and adjusting research in response to emerging variables. A compilation of works in Verweij and Thompson (2006) makes a strong case for such "clumsy" research. The authors propose *cultural theory*, which takes a middle road between poststructuralist and systems theories, recognizing social and cultural variety while also postulating that there are a limited number of fundamental forms of social organization. They argue that these fundamental forms (and combinations of them) will influence the way all societies interact with their environments. Thus, case studies such as this, if implemented in incremental, systematic, and comparative ways are both necessary and useful for building SES theories while accounting for local scale complexities which must be understood to increase the applied value of research. Quantitative perception data in combination with spatial analytical tools such as GIS are particularly useful for linking SES dimensions as they support comparability across space and time, allow for the integration of interdisciplinary data, and can be combined with additional analytical methods.

Dedication to Richard Pollnac (from Amy Diedrich)

Richard Pollnac was my major professor and, since then, has remained a friend and colleague. His enthusiasm and passion for his work make him a wonderful teacher and mentor. Perhaps most inspiring is the genuine care, interest, and respect he has for his students and their ideas—the exchange of knowledge and inspiration between Richard and his students is reciprocal. I feel extremely grateful to have had the opportunity to be motivated by his guidance in the past and into the future—thank you.

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