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# Are we there yet? Sense of place and the student experience on roadside and situated geology field trips

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## ABSTRACT

**Field work is an integral component of undergraduate geoscience education. Field areas for these crucial experiences are carefully selected, but how do these places affect our students? This study compares the field experience of students participating in two distinct modules of a study abroad field camp in New Zealand, through sense of place and perceptions of learning. The situated module was geological mapping based in a single site, whereas the roadside module was based on smaller exercises in multiple discrete sites. Survey findings indicate that students became significantly more attached to the situated field area, but had no significant change in their attachment to the roadside field area. Field observations and interview findings suggest that this may be due to student autonomy, the immersive landscape, and strong alignment of student perceptions of learning with instructor intentions on the situated field module. In contrast, the roadside module was more determined by the instructor, and student perceptions of learning did not align well with instructor intent in conveying a sense of the regional geologic history. We assimilate our field observations and student and instructor interview data into a schematic model of the two field trip styles. This model is then used to visualize an improved pedagogy to foster greater engagement with the landscape and geology in the roadside trip. We recommend that roadside field trips have explicit assessments that connect the field sites together. Our interview data suggest that this connection would be further enhanced with greater opportunities for student ownership of in-field decision making through student-centered learning, encouragement of a sense of exploration, and development of a student and instructor field learning community.**

## RESEARCH CONTEXT

### Field Education: Benefits and Styles

Field trips are widely used in geoscience education around the globe and in several other disciplines, including geography (e.g., Gold et al., 1991; Fuller, 2006), biology (e.g., Smith, 2004; Anderson et al., 2009), archaeology (e.g.,

Colley, 2003), and in-service teacher training (e.g., Crawford, 2007; Wee et al., 2007; Luera and Murray, 2016). In geoscience, field education is valued for its broad development of knowledge, skills, and scientific and professional identities (e.g., Boyle et al., 2007; Kastens et al., 2009; Whitmeyer et al., 2009; Feig, 2010; Petcovic et al., 2014). Field work is often used to market particular courses or programs of study (Fuller, 2012). Previous research in field education is vast, covering topics such as technology in the field (e.g., De Paor and Whitmeyer, 2009; Feig, 2010), expert-like mapping traits (e.g., Petcovic et al., 2009; Riggs et al., 2009; Dohaney et al., 2015), building multidisciplinary and interdisciplinary connections (e.g., Barrett et al., 2004; Anderson and Miskimins, 2006), and access and inclusion (e.g., Atchison and Feig, 2011; Gilley et al., 2015). Much like the vast pool of research on field education, pedagogical approaches to field trips vary widely.

Field trips in geoscience range from day and/or weekend trips through to multimonth (summer) field courses and/or camps (Whitmeyer et al., 2009). Some instructors opt to maximize diversity of sites visited, while others maximize time spent in a single area (Lonergan and Andresen, 1988; Gold et al., 1991). Lonergan and Andresen (1988) characterized the practical variations of geography field trips with respect to three factors: travel distance, time spent, and availability of educational activities; they described five combinations of these factors: limited travel and/or limited time (laboratory exercises, campus field work, day trips), limited activity and/or extended travel (roadside trips), extended travel and/or extended time (mapping trips with limited sites, residential field camps), multilocation activities (travel between states or countries, study tours), and learner practitioner and participant observation (conducted as a part of that community). Field trips that involve more extended activities tend to promote more student-centered learning (e.g., O'Neill and McMahon, 2005; Baeten et al., 2010) and may more easily incorporate project-based (e.g., Blumenfeld et al., 1991; DeWaters et al., 2014) or problem-based learning approaches (e.g., Kahn and O'Rourke, 2004; Charlton-Perez, 2013).

Field educational environments are complex, where variables unique to the non-classroom setting become important (e.g., inclement weather, injuries, or accidents; Stokes and Boyle, 2009). Any unexpected change in trip variables might result in a field trip changing from an extended time and/or extended travel trip to a limited activity and/or extended travel trip. Such influences in

the field increase demands on students' cognitive load (Orion and Hofstein, 1994; Boyle et al., 2007) and strengthen the need for a thorough consideration of the affective domain (attitudes, emotions, and values) when researching field education.

### Importance of the Affective Domain in Field Education

Discussions in the geoscience education literature often focus on the cognitive domain, or what students know. The affective domain, or why they learn, is not as widely studied in geoscience (e.g., Boyle et al., 2007; Stokes and Boyle, 2009; McConnell and van Der Hoeven Kraft, 2011; van der Hoeven Kraft et al., 2011; Jolley et al., 2012; LaDue and Pacheco, 2013). It can help us understand why students study geology and why they keep studying it (van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013). Previous work on the affective experience in earth science suggests that students have largely positive feelings toward field education before the trip and these feelings become significantly more positive after the trip has finished (Boyle et al., 2007). Some negative affective responses are apparent at the beginning of field trips and anxiety about the unknown tends to be common; however, these negative affective responses disappear by the end of a field trip (Boyle et al., 2007). Students appreciate the importance of field education, value its group work components, and enjoy being challenged in the field (Boyle et al., 2007). Subsequent work by Stokes and Boyle (2009) further supports these findings, and highlights the importance the affective domain in promoting deep approaches to learning, or learning for understanding, rather than the rote memorization of surface learning (Marton and Säljö, 1984; Trigwell and Prosser, 1991).

Motivation in part determines student approaches to learning, by driving the why and how behind these processes (e.g., Bandura, 1977; Dweck, 1986; Deci et al., 1991; Eccles and Wigfield, 2002; Entwistle and Smith 2002; Deci and Ryan, 2008). Through their self-determination theory for motivation, Deci et al. (1991) identified three needs that influence student desire to achieve certain learning outcomes: (1) competence, (2) relatedness, and (3) autonomy. These factors are all relevant in the field and may be affected variably by differing styles of field trips. Feelings of competence are dependent upon whether students feel prepared for and/or anxious about the field trip, which may be a particular challenge at the beginning of a field trip (Orion and Hofstein, 1991; Boyle et al., 2007; Stokes and Boyle, 2009). Field work has considerable opportunities to develop a sense of relatedness and community, because students tend to bond with their peers and instructors more readily when in close quarters and social barriers have been reduced (e.g., Gold et al., 1991; Fuller, 2006; Stokes and Boyle, 2009). Student autonomy varies with style of trip and therefore, differing instructor input in the field (Lonergan and Andresen, 1988; Gold et al., 1991).

Students who are intrinsically motivated are driven by their own interest or desire to understand (Deci et al., 1991). More intrinsically motivated students have greater conceptual understanding (Grolnick and Ryan, 1987) and

are more positive about, satisfied with, and persistent with their learning (Vallerand and Bissonnette, 1992) than students with lower intrinsic motivation. More intrinsically motivated students have also been shown to hold increased interest and enjoyment in their learning (Benware and Deci, 1984). It could be argued that an engagement with geoscience and the Earth is the ultimate goal of geoscience education experiences, fostering an interest and drive to learn more and to become better at self-regulating that learning, independent of a particular topic or instructor.

### Sense of Place in the Field

In proposing a new framework for the affective domain in the geosciences, van der Hoeven Kraft et al. (2011, p. 72) defined a component unique to our discipline, termed "Connections with Earth." This component describes the possible ways that people relate to the Earth, including appreciation, wonder, values, and aesthetic. It is based upon theoretical and experimental findings, and intersects with peoples' motivation and emotions. van der Hoeven Kraft et al. (2011, p. 74) cited a previous session at the 2008 Geological Society of America Annual Meeting, "The Human Connection with Planet Earth: What is it and Why is it Important?," when they described this characteristic as "essential for our well-being" and "part of our motivation for learning geoscience"; they also suggested that harnessing or strengthening a student's connections with Earth may increase their desire to learn geoscience content by increasing their value in the landscape.

The connections with Earth component are grounded in previous environmental psychology work on "sense of place" (van der Hoeven Kraft et al., 2011), a term originating from human geography that describes a person's connections with a place through their attachment to it and meanings they see within it (e.g., Tuan, 1977; Brandenburg and Carroll, 1995; Williams and Stewart, 1998; Semken and Butler Freeman, 2008). Our perceptions of places are built upon past experiences and evolve through new interactions, which are sometimes shared with others (e.g., Tuan, 1977; Gustafson, 2001; Massey, 2005; Chen et al., 2014). Imagined through a geological lens and coupled with a cultural lens, each landscape carries with it a heritage of past occupation and environmental change, and it is through the interplay between each individual and each landscape that a new sense of place is formed.

Place attachment is one component of sense of place (e.g., Giuliani and Feldman, 1993; Hidalgo and Hernández, 2001; Williams and Vaske, 2003; Hernández et al., 2007; Scannell and Gifford, 2010) and is at the interface of connections with Earth and emotion in the affective framework for the geosciences (van der Hoeven Kraft et al., 2011). Place attachment is composed of largely, but not exclusively, of the degree of dependence on and identity with a locality (e.g., Williams and Vaske, 2003; Kyle et al., 2005; Chen et al., 2014).

Many geoscience field trips are not explicitly place based, where specific attention is given to the diversity of cultural meanings of the landscape in question (e.g., place names, environmental issues, indigenous knowledge).

Successful attempts to address these aspects and others through place-based geoscience have been highlighted in recent papers (e.g., Riggs, 2005; Semken, 2005; Semken and Butler Freeman, 2008; Williams and Semken, 2011; Monet and Greene, 2012), including a *Journal of Geoscience Education* special issue (Apple et al., 2014). Place based or not, geoscience students in the field are introduced to a range of disciplinary and instructor perspectives of the area; students inherently develop their own perspectives on the field place, even if this is not a part of the intended field trip curriculum. They leave the field area often with strong, long-lasting memories of the place, and some even revisit it. Prior work suggests that attachment to natural and recreational areas correlates with pro-environmental or environmentally responsible general behaviors (e.g., Vaske and Kobrin, 2001; Halpenny, 2010). Furthermore, prior experience with a place correlates with sensitivity to environmental impacts on that specific location (White et al., 2008). These connections may be useful not only in graduating students who are environmentally aware and considerate, but also in strengthening their intrinsic motivation for learning about the geology and earth system of a particular place.

### Research Questions

This study analyses two week-long modules of a six week New Zealand geology field camp for undergraduate students from the United States of America, with a New Zealand based study abroad company, Frontiers Abroad Aotearoa Ltd. (Dohaney, 2013; Hampton et al., 2015). The first module is map-

ping based around a single site (situated) and the second addresses independent tasks and skills at several geographically disperse sites (roadside). Neither of these modules is explicitly place based. Under consideration here is the sense of place that develops on field trips which have not intentionally addressed place, however are inherently grounded in place by asking students to study the landscapes around them. Following the links between the affective domain, sense of place, and field work, this study focuses on several research questions. (1) How do different types of field trips impact students' place attachment? (2) How does sense of place relate to perceptions of learning on the two differing field modules? (3) Are student perceptions of learning and instructor intentions aligned on the two differing field modules? How does this relate to sense of place?

## METHODS

### Research Setting

#### Study Participants

Students on the field camp were in their third year of post-secondary study; however, their previous experience with geology and geologic field work varied greatly, as they came from a variety of colleges and universities (see Table 1 for a detailed demographic breakdown). The predominant reasons students gave for enrolling in the field camp were its geologically comprehensive

TABLE 1. DEMOGRAPHICS OF STUDENT PARTICIPANTS

Characteristic	Variable	Trip n (total = 25)	%	Situated interview n (total = 5)	Roadside interview n (total = 5)
Gender	Female	17	68	2	2
	Male	8	32	3	3
Age	20	17	68	4	3
	21	7	28	1	2
	22	1	4	0	0
Ethnicity	Caucasian	22	88	5	3
	Asian	1	4	0	1
	Declined to answer	2	8	0	1
Major	Geology	14	56	3	2
	Geology and other science*	7	28	2	1
	Environmental geoscience	2	8	0	1
	Geology and other non-science	2	8	0	1
Number of geology field trips previously attended	0	1	4	0	0
	1–2	10	40	1	5
	3–4	10	40	4	0
	5+	4	16	0	0

\*Includes geochemistry and geophysics majors.

nature (covering all rock types in a variety of settings), the ability to fulfill a field camp requirement at their home institution and combine it with a semester study abroad, the desire to travel somewhere new, and the reputation of New Zealand's field geology.

Students were taught by different instructors throughout the field camp, to ensure that they were introduced to many geological sciences faculty and postgraduate students that they would encounter throughout their study abroad semester at the University of Canterbury in Christchurch. The instructors for the first module (situated) were specialists in: (1) structural geology (lecturer), (2) paleoseismology (Ph.D. student), and (3) regional tectonics and terrane analysis (lecturer); the latter instructor was on the trip in an advisory capacity and had less direct involvement in the module pedagogy than the other two instructors. For this reason, this instructor (regional tectonics and terrane analysis) was not included in this study. The instructors for the second module (roadside) were specialists in: (1) volcanology (lecturer), (2) metamorphic petrology and tectonostratigraphy (research scientist), (3) active tectonics and tectonic geomorphology (lecturer), and (4) mineral textures and crustal history (visiting lecturer).

### Field Camp Curriculum

The Frontiers Abroad (FA) field camp curriculum comprises five modules in five different locations, two of which are considered here (Hampton et al., 2015; Fig. 1). Each of these modules has a different goal and geological focus, with

a general progression from introductory navigation and mapping to conducting independent mapping and research (Hampton et al., 2015). This study was conducted during modules 2 and 3, at Cass and Westport, both on the South Island of New Zealand (Fig. 2).

The field locations both have established field stations owned and maintained by the University of Canterbury for use in teaching and research. Each has comfortable bunks, a large commercial kitchen, running water, power, heating, and (semireliable) wireless internet. The Cass field station is only 5 min from a major highway and rail line, yet in a town with a permanent population of one; it is within the Southern Alps and feels almost completely isolated. The situated-style module taught in the Castle Hill Basin focuses on detailed geologic mapping of sedimentary sequences in a single, discrete area ~30 min drive from the field station (trip parameters are highlighted in Table 2). Students compile a detailed stratigraphic log, map geological contacts, structures, and geomorphology, and prepare geological cross sections (Fig. 1). These assessments are completed individually, but students work in mapping groups of three to four (Table 2), collecting data and discussing possible explanations and interpretations together.

In contrast, the Westport field station is in the middle of a small coastal town suburb; in fact, the suburb was built around it. The roadside-style module focuses on strengthening observational and data collection skills and developing research questions (Fig. 1). The field sites visited are spread both north and south of the field station and the group visited up to two sites in one day, driving a maximum of 75 min each way (Table 2). Sites typically involve one rock type; however, lithology and structure vary between outcrops at each site.

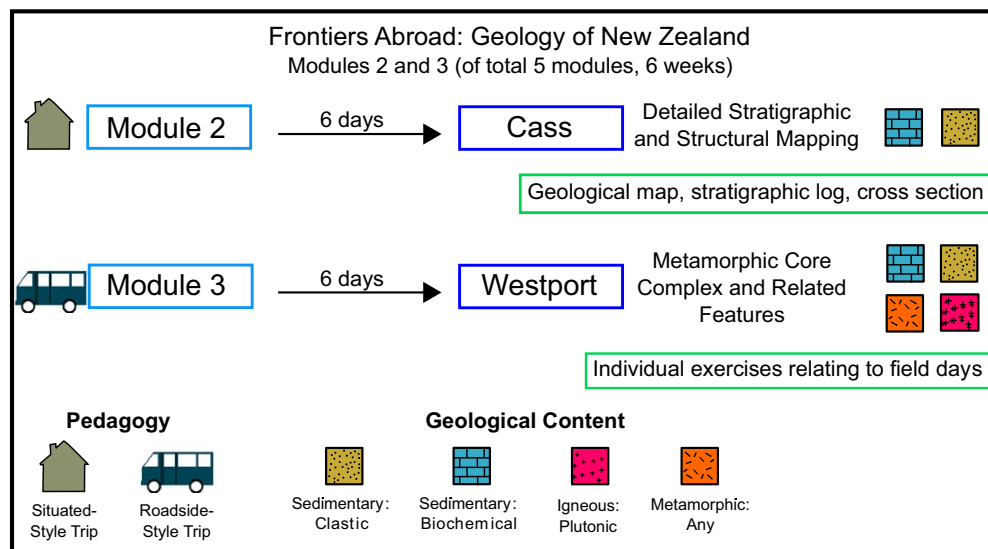


Figure 1. Frontiers Abroad Field Camp Curriculum. Only modules referred to in this study are included.

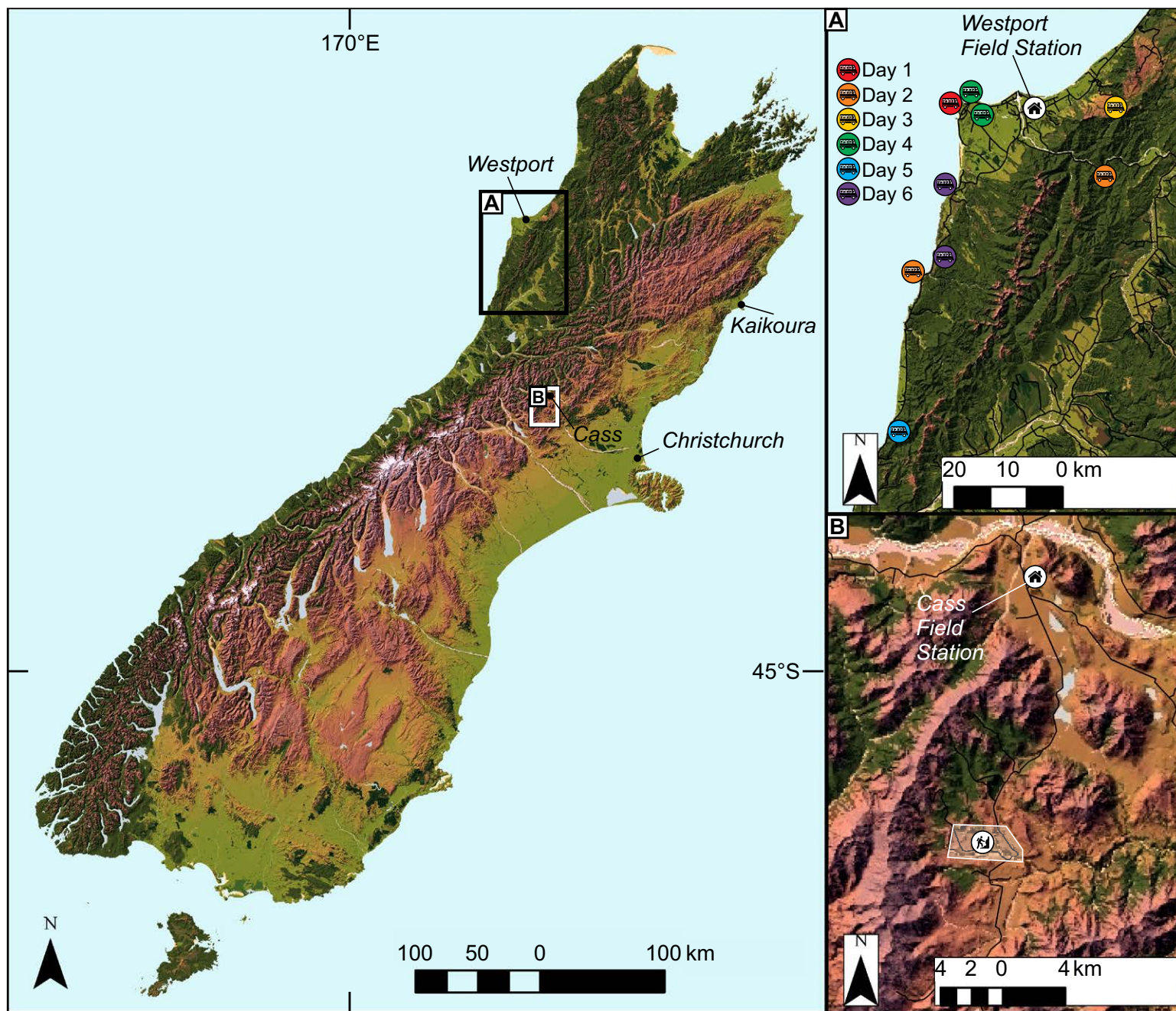


Figure 2. Map of field module locations and sites (A, Roadside; B, Situated), South Island, New Zealand. The roadside module contained nine geographically disperse sites visited over six days, whereas the situated module concentrated on one discrete mapping area over the same time frame.

TABLE 2. FIELD MODULE PARAMETERS: SITUATED VERSUS ROADSIDE

Characteristics of field module	Situated	Roadside
Approximate distance from previous location	279 km, 3.5 h	222 km, 3 h
Approximate average daily travel time (min)	60	75
Maximum daily travel time (min)	60	150
Number of field sites	1	9
Approximate size of field area (km <sup>2</sup> )	8	500
Number of teaching staff	3 instructors, 2 teaching assistants	4 instructors, 2 teaching assistants
Size of peer groups	3–4	12–13 or 25
Assessment tasks	Geological map, stratigraphic log, cross section	Individual exercises relating to field days (observation, recording, interpretation)

These lithologies span the range of sedimentary, igneous, and metamorphic rocks and sequences (Fig. 1). Students complete a number of small assessments relating to field days and sites, although not all sites have a required assessment. Although students collaborate when working back at the field station, these exercises are much more individual in nature, as they visit field sites in groups of 10–12 and do not work in smaller groups in the field (Table 2).

### Researcher

The researcher (one of us, Alison Jolley) accompanied the field trip as a nonparticipant observer, in order to collect data that would help contextualize survey and interview findings by characterizing the field environment; Jolley was unable to answer student questions relating to the geology or assessment. The students were aware that she was a Ph.D. student in geoscience education, who focused specifically on field experiences and sense of place. Jolley holds degrees in geological sciences and geoarchaeology, attended a number of field trips as an undergraduate and postgraduate student, and also has served as a teaching assistant on many field trips around New Zealand, including previous years of the FA program. Jolley is from Canada, and therefore able to relate to the students' experiences in cultural unfamiliarity and adjustment upon their arrival in the country.

### Quantitative and Qualitative Measures

This study used a mixed-methods approach to investigate student and instructor place attachment, wider sense of place, and perceptions of teaching and learning (Fig. 3). Quantitative survey data provided a concise and broad characterization of the research population's place attachment (see following). However, the complex and difficult to quantify nature of perceptions meant that there was a richer detail and causation that could only be obtained from qualitative data. A sub-sample of interviews with students and instructors (see discussion of Interviews: Perceptions and Philosophies) were conducted to uncover how their place attachment fit into their wider sense of place (including place meanings), and how this related to the field learning experience. Field observations (see discussion of Interviews: Perceptions and Philosophies)

were collected by the researcher to understand the field experiences of the research population first hand and contextualize the survey and interview data. The following discussions describe in more detail each of these quantitative and qualitative measures.

### Place Attachment Inventory

Students ( $n = 23$ , situated;  $n = 25$ , roadside; 2 students did not complete post-surveys on the situated trip and therefore did not have matched pre- and post-data) and instructors ( $n = 3$ , situated;  $n = 4$ , roadside) were surveyed for their attachment to the field area, using the validated Place Attachment Inventory (PAI; developed by Williams and Vaske, 2003; named by Semken and Butler Freeman, 2008). Students completed surveys before and after each field module and instructors completed only one survey, during the field module. Surveys were completed on paper or digitally, dependent upon their own preference and the reliability of the field station internet at the time. The PAI measures place identity and place dependence to determine sense of place through landscape value. It was validated using visitation of recreational landscapes in Colorado, Illinois, and Virginia (Williams and Vaske, 2003). Williams and Vaske (2003) found significant differences between a person's place attachment and them having visited it 0–2 versus 3–6 times, indicating that even a short amount of time in a landscape is enough to foster an attachment with it. Semken et al. (2009) found significant differences only between never having visited a site and having visited it one or more times. The PAI compares the place in question to other places anywhere in the world or in their home country (generically), and therefore the respondent's overseas travel experience is of limited relevance. Furthermore, the comparison in this study is a pre-trip to post-trip comparison of the same students, and therefore both data sets had the same travel experience. The PAI has been found to be applicable to additional locations throughout the United States and has previously been used in geoscience to evaluate the impact of a place-based introductory geology course (Semken and Butler Freeman, 2008).

In this study, place names have been changed to "Cass" and "the Westport field sites" and wording only modified to be grammatically consistent with the plurality of these place names. These names reflect the colloquial terms used

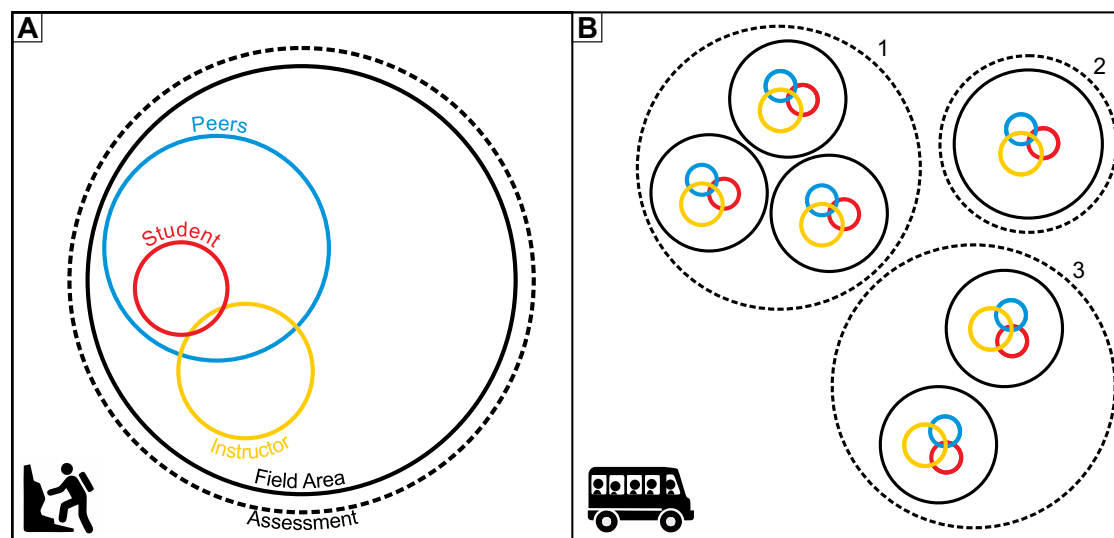


Figure 3. Field trip design in this study. Student, instructor, and peers colored circle sizes differ to show the amount of input that each group had relative to one another. Note that these sizes and the positioning of each circle are schematic only and not based on quantitative measures. (A) Situated: Students worked within peer groups and occasionally interacted with instructors. These peer groups worked together towards a unifying assessment constantly situated within the field area. (B) Roadside: Students worked largely individually and occasionally interacted with peers and instructors. Note that instructor input here is relatively larger than in B, because the instructors dictated the field plan considerably more in the roadside module than in the situated module, while moving students and peers from field site to field site. Students completed smaller assessments that involved either single (e.g., assessment 2) or multiple (e.g., assessments 1 and 3) field sites. However, there was no broader assessment that encapsulated the field area and hence, connected all the discrete field sites together.

for the field area in discussions with the students. The “Westport field sites” concisely refers to the collection of field sites visited on the roadside module to capture the overall experience of the students, rather than their attachment to individual field sites. The same instrument administered to the student participants was used to measure place attachment of instructors on the field trips. Both the student and instructor data sets were analyzed following the methods described by Semken and Butler Freeman (2008). Responses to the 12 statements were scored from 1 to 5 on a Likert scale, from strongly disagree to strongly agree, with the negative statement “the things I do at (place name) I would enjoy doing just as much at a similar site” reversed scored. Possible PAI scores range from 0 to 60, with a score of  $\geq 36$  indicating place attachment and  $< 36$  indicating place aversion.

On the first survey, basic demographic information was collected from the students, including their prior field, work, and outdoor experience, and their reasons for enrolling in the field camp (Table 1; see Appendix 2 for a list of survey questions). Instructors were asked about their experience leading geoscience and other outdoors courses, prior visits to the field sites, and interest in teaching that particular field module.

### Observations: The Field Experience

Field observations served to keep a running log of the field trip events and contextualize the survey and interview data. The observations did not follow a set protocol, but rather took the form of a thick description. Thick

description is used widely in ethnography to describe cultural groups, and represents a log of what behaviors happened and where (Geertz, 1973), as well as details, emotions, and impacts related to these happenings (Denzin, 1989; Ponterotto, 2006). Similar methods have been used in other studies in geoscience education (e.g., Feig, 2010; Atchison and Feig, 2011). Observations were taken by hand in a field notebook, as the researcher moved throughout the field. These observations were primarily general in nature, however, with specific attention to place attachment (references to the landscape and/or participants’ relationships with the field area) and engagement (were participants attentive and did they seem to be interested in their work?).

### Interviews: Perceptions and Philosophies

Interviews were conducted with students and instructors in order to understand in more detail their perceptions of the field trip, the types of information covered on the PAI (field area, sense of place), and the background information provided on the surveys (see Appendix 3 for a list of interview questions). The interviews were exploratory in nature; however, the analysis (described in more detail in the following) was organized by research question (Cohen et al., 2007). Student and instructor interview findings were compared where the research question necessitated this (research questions 3 and 3a: Are student perceptions of learning and instructor intentions aligned on the two differing field modules? How does this relate to sense of place?).

Because it was not feasible to interview all 25 students, purposive sampling (Cohen et al., 2007) was necessary. In this case, a random or a self-selected sample would not have been useful for understanding the extent of a potentially wide range of perceptions of field experiences. Instead, a deliberate sample strategy was enacted, where the researcher (Alison Jolley) selected five students who represented differing peer groups and a range of demographic, attitudinal, and aptitude characteristics (Table 1). These choices were informed by instructors and teaching assistants who had better knowledge of the students and their personalities than the researcher and incorporated factors additional to Table 1, such as the student's comfort within the field area. The interviews represent the perceptions of this subsample and are not generalizable to the overall study population, but are instead used to understand survey responses in greater detail. Five different students were interviewed for each of the two modules. Time constraints and the need to avoid overloading the students meant that some students were not interviewed until at maximum three days following the module. These interviews were semistructured and conducted inside and/or outside the field station or campsite, away from their instructors and peers. The interviews ran an average of 26 min, with a maximum of 38 and a minimum of 17 min.

All faculty instructors included in the study were interviewed ( $n = 6$ ). Most interviews were conducted in the instructors' office, others via Skype. Interviews were semistructured and had an average length of 48 min, with the longest running 78 min and the shortest, 26 min. Instructor interviews were completed within the year following the relevant module. As time in the field was limited, it quickly became apparent that priority would need to be shifted to completing student interviews while on the field trip. It was expected that instructor perspectives would be much less changeable and time or location sensitive, as their sense of place would be based on a rich collection of experiences in the field landscape constructed over a number of years (Stedman, 2003).

All interviews underwent content analysis (Cohen et al., 2007) using an iterative process of coding and verification. Coding through content analysis serves to reduce large volumes of qualitative data to a smaller list of themes, effectively summarizing the responses of (in this case) the interviewees. Coding may be perceived as a subjective process, particularly in cases (such as this study) where cross-coder comparisons are not feasible and dependent on the description and interpretation of the researcher. A more inductive approach was used, in which codes (and therefore themes) were allowed to emerge from the data, rather than using an a priori list of codes, to partly counter for subjectivity. While this approach is more time consuming, it forces the researcher

to stay close to the data without any preconceived ideas about findings and themes. Emergent themes were checked in the data for counterevidence as a second step in establishing trustworthiness of the themes. Themes were also triangulated across the range of quantitative and qualitative data in the study. Coding methods included a mix of in vivo (interviewee's exact words), process (interviewee's actions), emotion (interviewee's feelings), and evaluative coding (interviewee's values; Saldaña, 2009).

The analysis was constrained to the subset of content relating to the research questions (e.g., Miles and Huberman, 1994; Cohen et al., 2007). For the student interviews, the analysis focused on sense of place in the field area and perceptions of their learning on the field trip (research questions 1–3). Instructor interview analysis focused on instructor intent in teaching the field module (research question 3). After relevant sections of the interview were identified, a first pass with each data set revealed emergent codes, subcodes, and categories. Codes represent the initial level of summary data used in the content analysis. Any descriptions or reflections that were more specific or detailed were classified as subcodes. For example, if an interviewee first said that they summiting a hill was a memorable experience for them but then also said that it was memorable because they felt satisfied, the code used (process) could be "summitting" and the subcode could be "felt satisfied" (emotion). Categories were used to group codes (and any associated subcodes) together to provide a broader summary level. In the example used here, the category could be "positive memorable experiences." Following the initial list of codes, subcodes, and categories, a second pass was completed to refine and produce an initial frequency analysis of codes and/or subcodes. A third pass was done with the refined list of codes and/or subcodes, producing a final code frequency. The interview themes described in the following sections are all codes, although generally discussed by category, i.e., with related codes.

## FINDINGS

### Survey Findings: Place Attachment

After the situated module, average student place attachment shifted significantly toward the positive [32.4–39.7/60; nonparametric paired t-test (Wilcoxon test),  $p < 0.0001$ ; Table 3]. Instructors on the situated module ( $n = 3$ ) had place attachments of 37 and 41 out of a possible 60 (Table 4). In contrast, there was

TABLE 3. STUDENT PLACE ATTACHMENT RESULTS

Trip type	n	Pre	Post	Shift
Situated	23	32.4 (6.6)	39.7 (7.0)	7.3 (5.3)*
Roadside	25	30.3 (6.8)	31.8 (6.8)	1.5 (6.6)

Note: Maximum score of 60, >36 indicates positive (more than neutral) attachment. Standard deviation is in parentheses.  
\*Nonparametric paired t-test (Wilcoxon test),  $p < 0.0001$ .



TABLE 4. INSTRUCTOR PLACE ATTACHMENT RESULTS

Trip type	n	Instructor 1	Instructor 2	Instructor 3	Instructor 4	Student average (post)
Situated	2	37	41	N.A.	N.A.	40
Roadside	4	38	43	44	45	32

*Note:* No instructors were the same between the two modules. Maximum score of 60, >36 indicates positive (more than neutral) attachment. N.A.—not applicable.

no significant change in average place attachment of the same students on the roadside module [30.3–31.8/60; nonparametric paired t-test (Wilcoxon test),  $p = 0.71$ ; Table 3]. Instructors on the roadside module had place attachments of 38, 43, 44, and 45 out of a possible 60 (Table 4).

### Field Observations

Field observations on the situated module confirm that students mapped in small groups and therefore made group decisions about where to go which were not dictated by the instructor. Students also decided what to describe and measure and took their own steps to interpret those data (both individually and as a group). Additional observations showed that the instructors reinforced this ownership by telling them that they were looking forward to seeing what they “create.” The direction and feedback that the instructors provided was largely focused on supporting the students so that they could effectively complete the final map, stratigraphic log, and cross section. This assessment required the integration of multiple data sources through interpretation of the field landscape. The instructors also emphasized rock description and recording of observations before jumping to an interpretation or idea. Students responded positively to this pedagogy and assessment, and appeared to be attentive and confident throughout the majority of the module.

On the roadside module, field observations support that tasks at all of the field sites visited were focused heavily on making interpretations through instructor-directed Socratic discussions at each site, a change from the previous module. These interpretations were only sometimes related to the geologic history of the region, despite this being identified as a guiding principle for the module (Table 2). Although the goal of understanding the regional geologic history was occasionally reinforced in the field, observations confirm that students did not have an assessment or activity that tied the sites together throughout the region. Furthermore, the trip content was varied and spatial distribution of sites was wide, as was the scale of investigation at each site. The instructors decided where to take the students and helped locate them when the group arrived at each site. Instructors often needed to reinforce the locations of each site multiple times. Students appeared frustrated, underconfident, and easily distracted at a number of the field sites, particularly when the purpose and context of that site was unclear and when multiple sites were visited within one field day.

### Interview Findings

#### *Student Interviews: Situated Module*

At least three of the five interviewees on the situated module indicated that they appreciated the field area aesthetic and specifically described and noted its dramatic or striking topography.

It was beautiful...and like hiking around and um, like you're kind of looking down at the trail and then you look up and just surrounding you are mountains...it always just strikes me how like you're hiking and you look up and it's like there's no flat land. It's just, everything's kind of coming towards you. Um, which is kind of like dizzying but really awesome. (Situated Student 2)

A number of other themes relating to sense of place were identified in at least two of the interviews on the situated module: familiar with field area aesthetic, “vantage points,” geology readily apparent in landscape, “huge” area, “cover a lot of ground,” stream crossings (as a minor inconvenience and notable event), field station added to experience, and increased geological understanding deepens feelings. Note that quotations indicate when an interviewee's exact words are used to define a code (in vivo coding).

I mean my perceptions have changed with the greater knowledge that I've gained about it. Like as I, as I understand more about what's been going on in this area, it deepens my feeling of what it is...you sort of get a sense for everything that's going on. (Situated Student 1)

One perception of the situated module was mentioned in three interviews: time management. Four other themes were recognized in at least two of the interviews: useful to have stratigraphic context, “figure out the structure of the area,” build confidence, and data collection.

But I think that's maybe another thing that you know, they were trying to help us learn, or show us that we needed to learn, was how to manage your time and manage the locations you want to go to. (Situated Student 3)

#### *Student Interviews: Roadside Module*

One theme relating to sense of place was consistent in three of the five roadside module interviews: appreciated field area aesthetic.

On the drive it was just like, the ocean. It was just like staring at the ocean the whole time. And just like marvelling at how large the waves are. 'Cause I've never been in a place where waves are so large. (Roadside Student 1)

Other sense of place themes were apparent in at least two of the interviews: unfamiliar landscape, appreciated being in New Zealand, appreciated module geology, novel geology, varied module geology, coastal geological exposure, “the abandoned coal town,” and nearby town amenities.

A variety of perceptions of the field trip learning was identified in the five interviews. One of these occurred in three interviews: developing research questions. Five other themes were identified in at least two interviews: “understanding metamorphic core complexes,” optical mineralogy, real life examples, field days too long, and lack of own background knowledge.

I think it's been, I mean I don't know, maybe my interpretation is different, but I felt like they're trying to get us to think more openly in the field, or something. And really like take a piece of whatever we're seeing in the trip and like try and pose a question. (Roadside Student 2)

### ***Instructor Interviews: Situated Module***

Interviews were conducted with the two situated module instructors involved in the study. Both instructors interviewed indicated that the focus of the module was on building knowledge and skills for a final task (map, cross section, stratigraphic log), with particular emphasis on developing rock description skills. They also both indicated that they intended to leave students feeling like they had ownership over their in-field decisions and work, and therefore, their learning outcomes.

But the context is they've already learned a few skills in Kaikoura [previous module not discussed in this study] and the purpose of Cass [situated module] is for them to produce this geological map using these skills that they've learned...And to do that you need to do good descriptions of your rock units. And along with the geological map you do a cross-section...the purpose of Cass is to make sure the students have what it takes to do that. (Situated Instructor 2)

Other goals individually mentioned by one of the instructors (but not both) were: apply knowledge previously learned, challenge, engagement, enjoyment, facilitate student-staff interaction, interpretation, mapping, rock identification, and safety.

### ***Instructor Interviews: Roadside Module***

The most commonly mentioned intentions for the roadside module (mentioned by three of the four) were teaching the content of the regional geologic history and developing students' interpretation skills.

I'm trying to make sure that they understand the task of collecting observations in the field and recording those and learning how to ask themselves questions...it's really important for them to learn that skill of just collecting hard data by uh, investment of time and effort on the outcrop versus getting the buzz of then interpreting that, in terms of the setting or the geological history of the area. (Roadside Instructor 4)

Other goals mentioned by two of the four instructors were the development of: student autonomy, rock description skills, note-taking skills, observational skills, and learning the content of igneous and metamorphic rocks.

## **DISCUSSION**

In this discussion we aim to use our place attachment survey data, field observations, and student and instructor interviews to address how students develop a sense of place and experience their learning on situated and roadside field trips. We answer this overall aim by addressing our research questions sequentially and concurrently developing a schematic representation of each field module that may be used to guide future field trip development (Figs. 3 and 4).

### **How Do Different Types of Field Trips Impact Students' Place Attachment? (Research Question 1)**

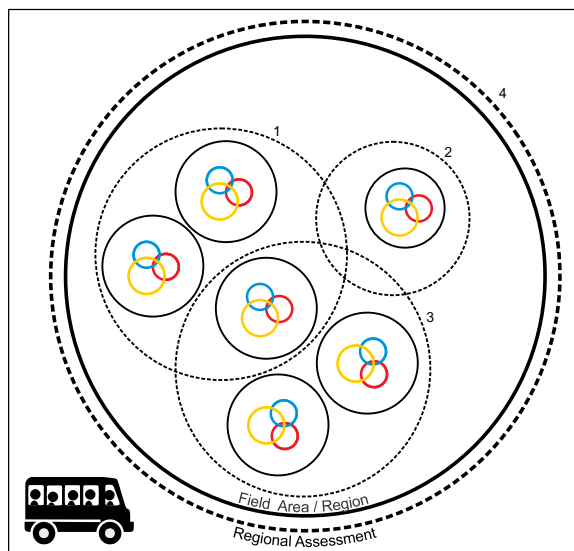
Students on the situated module became significantly more attached to the field area, with an average post-trip attachment of 39.7/60. In contrast, the same students on the roadside module had no change in their attachment to the field area and averaged a slight aversion to the field sites post-trip (31.8/60). Only the situated module produced an average place attachment higher than that of students in a traditional (non-place based) introductory geology course (35.3/60; Semken and Butler Freeman, 2008). Roadside trips may need more concerted attention to connecting students to the landscape and/or field area (Fig. 3), in order to better foster attachment with these places and strengthen links to the affective domain (Semken and Butler Freeman, 2008; van der Hoeven Kraft et al., 2011; LaDue and Pacheco, 2013).

### **How Does Sense of Place Relate to Perceptions of Learning on the Two Differing Field Modules? (Research Question 2)**

The model for the affective domain in the geosciences highlights three concepts that address how motivation and emotion relate to connection to Earth: (1) modeling appreciation, (2) place attachment, and (3) connections to aesthetic (van der Hoeven Kraft et al., 2011). The former (modeling appreciation) is best addressed in the interrelationships between instructor intent and student perceptions, addressed in the following (research questions 3 and 3a). The latter two (place attachment and connections to aesthetic) refer to aspects of the student's own sense of place and are relevant to research question 2. Findings from interviews and observations are incorporated here to address these concepts and their relationships to student perceptions of learning.

Student interviewees noted that they appreciated the aesthetic of the situated field landscape, its dramatic topography and vantage points. Some stu-

**Figure 4. Recommended design for roadside field trips.** Student, instructor, and peers colored circle sizes differ to show the amount of input that each group had relative to one another. Note that these sizes and the positioning of each circle are schematic only and not based on quantitative measures. The recommended design for roadside field trips includes: (1) increased interlinking of smaller assessments (e.g., assessments 1–3) and (2) a regional (field-area wide) assessment (e.g., assessment 4), which serves to link all field sites and assessments. These recommendations serve to promote greater student place attachment and engagement with the entirety of the field area or region.



students even remarked that it had a familiar feel to them. These positive feelings were reinforced by the field station setting, which was similar to the aesthetic of the mapping area, despite being a 30 min drive away. The field station setting continued the immersive nature of the situated environment.

Previous work has found that a sense of place and appreciation of landscape develop strongly when pedagogy promotes geological inquiry (Ault, 2014). The structure and assessment of the module allowed considerable opportunity for students to be autonomous, navigate, and make a range of decisions in the field, largely without immediate or constant instructor feedback, and this more project-based approach appeared to promote high levels of engagement from the students. This engagement is consistent with research on student-centered (e.g., O'Neill and McMahon, 2005; Baeten et al., 2010) and project-based learning (e.g., Blumenfeld et al., 1991; DeWaters et al., 2014). The map, cross section, and stratigraphic log assessments defined the immersive experience of the situated module, and were inherently linked with the landscape by covering the entire field area (Fig. 3A). Students felt accomplished at mapping an area that seemed huge initially, but became more manageable over time as they covered more ground. They described growing feelings of attachment as they understood more about the geology, after only a week of working within that landscape. This illustrates a direct link between the students' own place attachment and their learning about the landscape.

Field observations showed that the roadside structure (multisite visitation at distances where driving is required) resulted in a more hands-on teaching experience (less student centered) where students had little autonomy. Students were more reliant on instructors for direction both in physical location and in

their own observations and interpretations through Socratic discussions at each field site (Dohaney et al., 2015). Field observations indicated that the students demonstrated less confidence and ownership of their data and work, and this is reinforced by interviewees' worries about their own lack of background knowledge. Although they stated that they enjoyed the varied and novel geology on the module, it was not enough to overcome these worries. Anxiety is common on field trips, particularly at the beginning of the trip or in new environments when students do not know what to expect (Boyle et al., 2007). The structure of the module and observations of the specific assessments confirmed that the concepts studied at discrete sites on the roadside module were not connected through a larger piece of assessment integrating and interpreting the landscape and region through a project-based approach, e.g., a regional geologic map, data summary, or large-scale paleogeographic model (Fig. 3B). Some students reported appreciation of the field area aesthetic and its variety, but this came second to their feeling of being spatially disoriented and fatigued when traveling varied, often long distances. Interviewees did not describe feelings of attachment as they did in the situated modules, an important link to the affective domain and student engagement (van der Hoeven Kraft et al., 2011).

Students on the situated module reported forging strong interpersonal connections, particularly in their small (3–4 person) mapping groups. Field observations indicated that students on the roadside module received less support and input from their peers, only occasionally interacting with each other (Fig. 3B). Group work, or at least autonomous group work, is less practical or necessary at the spatially constrained sites on the roadside module. Fuller (2006) compared an eight-day alpine physical geography extended travel and time trip to a one day rivers and coasts limited activity and extended travel trip, both in New Zealand. His results suggest that students on limited activity and extended travel trips get to know each other, but that interaction doesn't enhance their engagement with the material (Fuller, 2006). On trips with deliberate group work (e.g., residential field camps), students get to know each other and this social interaction improves their engagement (Fuller, 2006). Social learning has previously been found to be an important component of geoscience field work (Stokes and Boyle, 2009; Streule and Craig, 2016). Interactions with others are also critical factors in an individual's sense of place development (e.g., Gustafson, 2001; Kyle and Chick, 2007). It is possible that these social interactions and support experiences assisted in developing student sense of place on the situated module in this study.

### **Are Student Perceptions of Learning and Instructor Intentions Aligned on the Two Differing Field Modules? How Does This Relate to Sense of Place? (Research Questions 3 and 3a)**

In any curriculum setting, it is important to recognize both the intended curriculum, i.e., that which the instructors had planned to deliver (e.g., Porter and Smithson, 2001; Kurz et al., 2009) and the received curriculum, that which occurred in practice and how it was interpreted by the students (e.g., Cuban,

1992; Zamani et al., 2007). These may be compared by mapping the intended learning outcomes onto activities and assessments using the concept of constructive alignment, with the learner's perceptions and experience at the core (Biggs, 1996). Student sense of place may also be affected by how instructors model their own connections with Earth (van der Hoeven Kraft et al., 2011). Although in our case the instructors did not explicitly address place in their intended curriculum, it was still possible for students to develop a sense of place in their received curriculum.

On the situated module, both of the instructors had a positive attachment to the field area. Field observations indicate that all of the instructors on the situated module were focused on helping the students become more capable in the field, particularly toward the completion of their assessment. When asked about their learning on the situated module, students did not remark much on specific content and focused instead on transferrable skills. Time management was the most widely mentioned, and building confidence and data collection skills were also noted. This attention to transferrable skills aligns well with the instructors' self-reported focus on building skills and fostering a sense of ownership in the students. In contrast, there was much less alignment of student perceptions of learning and instructor intent on the roadside module.

Although the four instructors each had a positive attachment to the roadside field sites and they interacted more frequently with the students on the roadside module (Fig. 3B), students did not perceive the regional connections or importance of these in their learning. Where instructors saw teaching the regional geologic history as a goal, students saw "understanding metamorphic core complexes." This is indicative of the expert ability to see the sites as an interconnected whole (e.g., Bransford et al., 2000), whereas novices see a series of concepts. This awareness of the regional connections across the field area may explain the instructors' considerably higher place attachment to the roadside field sites. Instructors see the (implicit) landscape connections in the roadside module that students only see in the situated module where the connections through assessment are explicit (Fig. 3). The situated assessment with built-in landscape connections also served as a venue for instructors to model expert-like appreciation and awareness of the landscape. Three students on the roadside module mentioned the conveyed importance of developing research questions, but only one of the four instructors mentioned it. In this case, there is no assessment structure to link the landscape, model appreciation, and help to convey the broader (field-area wide) learning intentions of the instructors (Fig. 3B). Students were then left to draw their own conclusions not only about how the discrete field sites were connected, but why the instructors had chosen to highlight them.

### Implications of Findings on Further Field Trip Development

The situated field trips in this study had considerable inherent strengths in engaging students with the landscape and its geology, which were further strengthened by its larger, unifying assessment (Fig. 3A). Students developed

a strong sense of place in this environment, even when the curriculum was not explicitly place based. We can continue to leverage this in field trips of this type by supporting students in being autonomous learners, particularly through curriculum structures that encourage student decision making and exploration. The use of small group work may further support student engagement and connection with the geology by building peer relationships in the field (e.g., Tedesco and Salazar, 2006; Stokes and Boyle, 2009). In addition, we expect that the introduction of deliberate place-based curriculum through engagement with the cultural landscape to situated field trips will take what is already effective practice in teaching geoscience mapping one step further, and help to create a sense of responsibility for local communities and sustainable geoscience initiatives (e.g., Tedesco and Salazar, 2006; Semken and Brandt, 2010).

There is clearly a time and a place for roadside field trips, and they are designed as such to meet particular goals (Lonergan and Andresen, 1988; Gold et al., 1991), e.g., learning a range of geologic skills, exposure to a diversity of geology, or discovering the regional geologic relationships. However, the discrete field site structure on the roadside trip in this study did not support development of a sense of place or engagement with the field area as a whole, and therefore its geology. On the roadside trip in this study, students needed to use observations collected on a number of scales to unify complicating dimensions of time, depths, and processes through regional frameworks. This created a challenge that was spatially and temporally more expansive than on the situated field trip, particularly when these observations were not explicitly connected through a larger, unifying piece of assessment (Fig. 3B). We postulate that the use of such regional assessments (e.g., regional map, written geologic history) will help students to develop and maintain a sense of where individual sites fit within the landscape and geologic time scale (Fig. 4). Assessments such as these will be aided by a concerted effort from the instructors to model appreciation of these connections, and help students develop a sense of place in the field area. We further believe that it is not enough for the instructors to try and convey the wider field relationships, but that students need to discover this for themselves with enough assistance to mitigate anxiety over lack of subject-specific knowledge. Therefore, activities that encourage ownership, independently driven exploration, and a sense of community will be particularly helpful (Benware and Deci, 1984; Deci et al., 1991).

### Limitations

The field educational environment is one that is mentally stimulating and complex. Students experience the need to make complicated decisions and problem solve in physically challenging environments characterized by many intersecting variables, many of which are outside the instructor's control (e.g., Boyle et al., 2007; Kastens et al., 2009; Riggs et al., 2009; Feig, 2010; Baker et al., 2012; Hambrick et al., 2012). We have described our setting in detail (see discussion of Research Setting) and attempted to control for as many of these variables as possible (highlighted in the following).

### ***Above Average Student Population***

The students in this study selected, applied for, and paid for the intensive New Zealand field camp program, traveling across the world to participate. None of the students had ever visited New Zealand before and were excited to be in a new country where they could see active geological landscapes. The students were possibly more interested, motivated, and engaged than the average student studying in their own local area. This does not make the findings less valid, as despite these factors, students had a significant change in attachment on one module and no change on the other. However, overall attachment and potentially shifts in attachment may not be as strong on both situated and roadside field trips for differing populations (e.g., non-study abroad students).

### ***Curricular and Environmental Conditions***

Although the students on the two modules were the same, some differences between them could not be controlled for. The situated module is conducted in a mountainous environment, whereas the roadside module is predominantly a coastal landscape, although usually within view of mountains. The two are aesthetically distinct. As mentioned previously, the two modules are taught by an entirely different teaching team. While this was useful for keeping things fresh for the students, it also means that there was some variation between personal teaching styles and beliefs. The situated module occurred prior to the roadside module, meaning that the students may have been more fatigued for the roadside module, although they did have two days of rest time before beginning it. Regardless of how helpful the rest time was, the roadside experiences were built on the situated experiences, while the situated experiences were built on the students' first module, which was not part of this study. One variable that is undoubtedly out of our control, the weather, was uncharacteristically consistent between the two modules: warm, mostly sunny, with no rain for the two-week duration.

### ***Methodological Limitations***

Although the researcher's (Alison Jolley) observations were highly useful in providing context and triangulation for the student and instructor populations, it is important to remember that these still require interpretation of the behaviors observed. What the students and instructors are thinking is not always readily apparent, and interpretations are inherently affected by the researcher. All observations were taken by the same researcher (Jolley) and therefore carry with them the same bias, that of a person with largely positive past field experiences as an undergraduate and a North American in a foreign country.

## **CONCLUSIONS**

This study highlights key differences in two common geology field trip structures: situated (here geological mapping based) and roadside (here observation and skills based). This was achieved by contrasting survey, observa-

tional, and interview data collected on two, week-long modules of a six-week study abroad field camp to New Zealand, all with the same students. These students had a significant positive change in their place attachment to the situated field area, but showed no significant change in their place attachment to the roadside field area. Interviews and observations suggest that these differences in student sense of place are linked to perceptions of their own engagement and learning through interrelationships and interactions between the individual student, their peer group, their instructor, and the landscape while in the field (Figs. 3 and 4). These interactions helped and hindered the amount of ownership students were encouraged and able to take within these environments, which is also tightly connected to the assessment structure of the module. The situated trip focused on one mapping, cross-section, and stratigraphic log assessment, and required students to make navigational and data collection decisions in small groups of three or four. This occurred while being immersed within the same landscape each day, and a similar landscape at the field station, helping to keep the trip connected and students engaged. Students' perceived learning was consistent with instructor intentions of focusing on transferrable skills, rather than specific content.

The roadside trip involved considerable daily travel and a number of smaller assessments. Students had no need to make navigational decisions or work in small peer groups, instead relying more heavily upon the instructors' direction and knowledge. Student perceptions of what they were expected to learn focused heavily on specific content and concepts, whereas instructors described an emphasis on the regional geologic history, showing a mismatch between instructor intentions and student perceptions of learning. Assessment is a concrete way to convey intended learning outcomes to students and reinforce the connections between discrete sites. In order to foster stronger sense of place, affective connections, and therefore engagement with the wider geological relationships, we recommend that roadside-style field trips be explicitly connected through an assessment structure encompassing all the field sites visited in the field area. In addition, roadside trips could further be improved by promoting increased ownership and exploration among individuals and small peer groups, as well as a sense of community within the students, instructors, and landscape. Further attention to sense of place through incorporation of cultural aspects of both situated and roadside trips may strengthen connections with landscape and result in more environmentally conscious, community-oriented geoscience graduates with stronger intrinsic motivation.

### **ACKNOWLEDGMENTS**

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This research was approved by the Human Ethics Committee at the University of Canterbury.

## APPENDIX 1. DESCRIPTION OF MODULES IN THIS STUDY

### Situated Module (Cass)

Field module 2 examines the stratigraphy and structural geology of Castle Hill basin, located in the eastern foothills of the Southern Alps, inland Canterbury, New Zealand. This part of the course will focus on field mapping skills, including the compilation of a detailed stratigraphic column, mapping geological contacts and structures, geomorphic features, and preparing geological cross sections. The structural mapping concentrates on the complex folding best expressed by an Oligocene limestone unit, and we will be developing a structure contour map on this unit. This will develop an understanding of both the structural and geomorphic evolution of the basin, and subsequent uplift, deformation, and glaciations.

### Roadside Module (Westport)

Field module 3 integrates different types of geologic data to interpret a geologic history of the Buller District of the west coast region, South Island, New Zealand. This part of the field program is based in Westport. The key focus in this model is on the examination of a metamorphic core complex, its less deformed cover, and contemporaneous basin deposits reflecting the Cretaceous Gondwana breakup and related extension. The second focus is on the tectonic controls on the formation and evolution of the Cretaceous–Neogene basins of the region, and how this has been subsequently folded and faulted. The field program provides further in field training utilizing and developing basic field mapping skills such as the observation, recording, and interpretation of folded bedding–cleavage relationships, and furthers structural relationships at varying scales.

## APPENDIX 2. LIST OF SURVEY QUESTIONS

### Student Demographics

- Gender: \_\_\_\_\_ 2. Age: \_\_\_\_\_
- Ethnicity: \_\_\_\_\_
- Major(s): \_\_\_\_\_
- Year of Study: \_\_\_\_\_
- 5a. Previous Post-Secondary Qualification(s): \_\_\_\_\_
- 5b. N/A
6. Circle any courses from the list below that you have taken at university level.
 

Anthropology	Engineering (any)	History	Physics
Biology	English	Māori and Indigenous Studies	Sociology
Chemistry	Human Geography	Maths	Statistics
Education	Physical Geography	Philosophy	Te Reo Māori
7. List and describe up to 5 field-based courses (including short courses and professional development) you have taken in geology.
8. List and describe up to 5 outdoors or field-based courses (including short courses and professional development) you have taken outside of geology.
9. List and describe up to 5 employment positions you have held in geology, the outdoors, or a related field, starting with the most recent.
10. Have you visited New Zealand before? If yes, please describe when you have visited and what you have done here.
11. Describe why you enrolled in this particular course and field trip stream (where multiple streams were available).

### Place Attachment Inventory (Williams and Vaske, 2003)

Note that these questions were identical for students and instructors; "(place name)" was replaced with "Cass" or "the Westport field sites." For the latter, the statements were reworded to be grammatically consistent with the plurality of this place name.

The following questions ask about your perceptions of the locations of this field trip. Please circle the response below that best describes your agreement with each statement (strongly disagree through strongly agree). Remember, there are no right or wrong answers, just answer as honestly as possible.

1. I feel (place name) is a part of me.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
2. (place name) is the best place for what I like to do.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
3. (place name) is very special to me.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
4. No other place can compare to (place name).  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
5. I identify strongly with (place name).  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
6. I get more satisfaction out of visiting (place name) than any other.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
7. I am very attached to (place name).  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
8. Doing what I do at (place name) is more important to me than doing it in any other place.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
9. Visiting (place name) says a lot about who I am.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
10. I wouldn't substitute any other area for doing the types of things I do at (place name).  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
11. (place name) means a lot to me.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree
12. The things I do at (place name) I would enjoy doing just as much at a similar site.  
Strongly Disagree    Mildly Disagree    Unsure    Mildly Agree    Strongly Agree

### Instructor Demographics

1. Gender:
2. Ethnicity:
3. Circle all field trip course(s) led: (course codes for those included in the study)
4. List and describe all previous university qualifications.
5. Other than (course codes for those included in the study), list and describe up to 5 field-based courses (including short courses and professional development) you have led in geology.
6. List and describe up to 5 outdoors or field-based courses (including short courses and professional development) you have led outside of geology.
7. Have you visited (place name) outside of leading this field trip before? If yes, please describe when you have visited and what you have done here.
8. Describe your interest in teaching this course and particular field trip stream (where relevant).

## APPENDIX 3. LIST OF INTERVIEW QUESTIONS

The following questions are indicative only of the themes covered, as a semistructured interview protocol was used. The precise wording of the questions varied, as did the order in which they were asked and the follow up questions used.

### Student Interview Questions

1. The student's personal background
  - a. Where are they from?
  - b. What are they majoring in (solely geology, or double major)?
  - c. Why are they majoring that field?
  - d. When did they decide on their major?
  - e. Educational motivation or socioenvironmental perceptions of interest that arise from the questionnaire.

2. General perceptions of the field trip
  - a. What they like/dislike about it.
  - b. What do they think the purpose was? What did they learn?
  - c. What was most/least useful to learn?
  - d. When was it most/least engaging?
3. How the location contributes to or detracts from the field trip
  - a. Had they visited this location before? How many times? In what capacity?
  - b. What are the most/least beneficial aspects of the location, as an educational environment?
4. Local visitation and education (where "local" is defined specifically for each area)
  - a. What activities do they think locals participate in here?
  - b. What features of the area do they think locals should learn about?
5. Tourist visitation and education (from further afield than what is defined as local)
  - a. What activities do they think tourists participate in here?
  - b. What features of the area do they think tourists should learn about? Do they think this should differ from what locals should learn about?
6. Personal interest in the location
  - a. Would they return to this field trip location, in their own time?
  - b. What types of activities could they see themselves doing?
  - c. What are its most interesting/important features?
7. Impact of the field trip on their perceptions of the location
  - a. How would they describe their relationship with the location(s)?
  - b. Has the field trip changed their perceptions of its location(s)?
8. Any additional comments/questions that the interviewee introduces, based on the above series of topics.

## Instructor Interview Questions

1. The lecturer's personal background
  - a. Where are you from originally?
  - b. How long have you lived in Christchurch or New Zealand?
  - c. How much time do you spend in the outdoors here? What do you do?
  - d. How would you describe your research specialty?
  - e. How long have you been teaching this field course? What about other courses, at the University of Canterbury or elsewhere? Your university? How much time spent with Frontiers Abroad?
2. Perceptions of field experiences
  - a. Do you think field education is valuable for the development of undergraduate geoscientists? Why? Are there any negatives?
  - b. Can you think of any of your own examples as a student, demonstrator, or lecturer?
  - c. How do you think your students perceive the field experience? Why?
3. General perceptions of the field trip
  - a. What is the purpose of this field trip? Why?
  - b. How does field teaching differ from in class teaching?
  - c. What teaching methods work particularly well in the field? Which don't? Why?
4. How the location contributes to or detracts from the field trip
  - a. What are the most important educational features of this field trip location? Why?
  - b. How might this place further contribute to field teaching?
  - c. What is your ideal field teaching location? Why?
5. Impact of the field trip on their perceptions of the location
  - a. Have you visited this location outside of this or other field courses? If so, to do what?
  - b. Do you remember the first time you taught a field course in this location?
6. Any additional comments or questions?

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