

# Research and Thesis writing

## 3. Thesis structure guidelines

### 3a. Sample Abstract from Engineering, Biology & Commerce

### Example for Engineering



1. Research models and methods



2. Developing a research proposal



3. Thesis Structure guidelines



3a. Sample Abstract from Engineering & Biology



3b. Sample Introduction from Engineering, Biology & Education



3c. Sample Methods section from Biology, Engineering & Education



3d. Sample Results section from Biology & Education



3e. Sample Discussion section from Biology



3f. Sample Conclusion from Engineering & Education



4. Thesis writing and persuasion

## Learning objectives

This module will help you to:

- learn about various research models.
- prepare a research proposal.
- structure your thesis and its chapters.
- write convincingly of your research outcomes and implications



This research developed a hybrid heating process which can sinter yttria zirconia ceramics to nearly 100% of their theoretical density in a short time. focus of research

Following optimisation of the process, a detailed comparison of the properties and microstructures of conventionally sintered and microwave sintered samples of 3 mol% and 8 mol% yttria zirconia was performed. Identical thermal profiles were used for both types of heating. For both materials, microwave heating was found to enhance the densification processes which occur during constant rate heating. methodology

The 3 mol% yttria zirconia material exhibited a shift in the grain size/density relationship which favours densification, resulting in higher density samples with smaller grain sizes at densities below 96% of theoretical density. At higher densities, significant grain growth occurs. For the 8 mol% yttria zirconia material, the grain size 1 density relationship remained unchanged. Differences in the response of the two materials are attributed to the differences in the activation energy for grain growth, and in grain boundary mobility. Modulus of rupture and toughness of both microwave and conventionally sintered samples were similar. Results for constant rate heating for microwaves and conventional heating (temperature is increasing at a constant rate - in this case either 2°C or 20°C per minute - to a set maximum temp, then heating stopped) overall results for both materials after microwave sintering

Following isothermal heating at 1300°C, microwave heated samples were found to be significantly more dense than conventionally heated samples. The lower temperature also restricted grain growth once densification was approaching completion. results for constant temperature heating for microwaves and conventional heating (samples held at a set temp - 130°C - for set period) results for 3 mol%

When aged at 1500°C, grain growth in the 3 mol% yttria-zirconia was also found to be accelerated in the electromagnetic field, with exaggerated grain growth being observed. The larger grain size was reflected in an increase in transformability of the tetragonal phase. Grain growth in 8 mol% yttria zirconia was not significantly affected by microwave heating over the time period studied. results for 8 mol%

discussion of results

comparison between microwave and conventional heating/sintering

results for 3 mol% at 1500C

results for 8 mol% at 1500 C

These findings have significant implications for the commercial application of microwave sintering. The best way to take advantage of the benefits of microwave sintering for yttria zirconia ceramics would appear to be incorporation of dwell periods at temperatures in the 1200 - 1350 °C range in the sintering program.

significance of results

## Example from Biology

The yellow-bellied glider (*Petaurus australis*) is one of only a few mammal species that feed on plant and insect exudates. The research described in this thesis aimed to assess the importance of the diet on the behavioural ecology of the yellow-bellied glider. Gliders were studied in detail at two sites in New South Wales in quite different forest habitats. One site was near Bombala on the southeast tablelands and the other was near Kiola on the south coast. The following features of the behavioural ecology of the yellow-bellied glider are presented in this thesis: (i) the diet and foraging behaviour, (ii) a detailed examination of the influences on the sap feeding behaviour, (iii) the socioecology, (iv) the size of home-ranges, and (v) influences on the use of vocalisations.

focus of research  
fieldwork location  
scope of study

At both study sites, a detailed assessment was made of the contribution of various food resources to the diet. Direct observation was necessary to assess the diet because exudates are almost wholly digested and, the use of exudate indicators in the faeces allows only presence or absence to be ascertained. Exudates (eucalypt sap, insect honeydew, manna, nectar) accounted for approximately 75% of the diet of gliders at Bombala (based on the proportion of the observed feeding time) whilst arthropods accounted for the remaining 25%. Arthropods are believed to be harvested primarily to provide dietary protein which is virtually absent from exudates. In contrast, exudates accounted for 99% of the diet at Kiola and arthropods only ca. 1%. Gliders at Kiola spent 70% of their feeding time engaged in feeding on nectar (and presumably pollen) from eucalypt blossom. Most of the protein requirement of gliders at this site may have been satisfied by pollen digestion because glider faeces contained substantial numbers of pollen grains, most of which had lost their cell contents.

results for diet and foraging behaviour at Bombala (section i)  
results for diet and foraging behaviour at Kiola

Eucalypt sap was important in the diet of gliders at both sites on some occasions. Gliders obtained sap by cutting into the trunks of trees with their lower incisor teeth and licking the sap that exuded. This occurred on only a small proportion of trees within a home-range. The incidence of rainfall and the availability of alternative food resources have been suggested recently to account for this seemingly enigmatic behaviour. However, the occurrence of sap feeding was not related to rainfall at either Bombala or Kiola. Moreover, neither hypothesis accounts for the selection of only a small number of trees for sap feeding. Gliders were also selective in the species of tree utilised, with only a few of the available species being incised.

previous studies of sap feeding behaviour (section ii)  
this study did not support these hypotheses

An index of sap flow in both sap-site and non sap-site trees was obtained periodically. Gliders fed on sap only at times of high sap flow and trees used for sap feeding tended to have a greater propensity to elevate sap flow than trees not incised by gliders. Feeding bouts during the main sap feeding periods were of a long duration (ca. 65 min) but outside these periods gliders occasionally made brief (ca. 6 min) 'test' incisions into both sap-site and non sap-site trees. It is suggested that this behaviour of gliders allows them to assay trees for the amount of sap flow and it is only when this is above a certain threshold that gliders engage in sap feeding. At Kiola, high levels of sap flow were measured at times when sap feeding did not occur. This suggests that the abundance of alternative food resources, particularly of nectar, may on occasion influence the use of sap by gliders. Thus, elevated sap flow may provide a necessary precondition for sap feeding rather than ensuring its occurrence.

methodology for sap feeding study  
 discussion of results of sap feeding

An examination of the foraging behaviour of gliders at both sites revealed that gliders spend more than 80% of the time outside their dens feeding. When feeding time is coupled with time spent in other behaviours essential for foraging (i.e. gliding and climbing), approximately 90% of this time is accounted for. This is one of the highest values yet found for a mammal. It is suggested that this is due to the nature of the diet. Exudates are continuously renewed and can be quickly assimilated, but these food types are never sufficiently abundant to permit much time to other activities.

discussion of foraging behaviour (section i)

Gliders spent significantly longer periods in trees when feeding on exudates than when feeding on arthropods. Also, gliders tended to forage together in the same trees when feeding on exudates compared to when feeding on arthropods. Data collected at both sites suggest that the foraging behaviour of gliders is influenced, not only by the abundance of their food resources, but also by the rates of renewal. At Kiola, when eucalypts were flowering, gliders often had a choice - of remaining in single trees for long periods of time or visiting more trees and perhaps encountering higher standing crops of nectar. Gliders were always highly selective in their choice of flowering trees in which to feed, choosing those with more than twice as many flowers as on a randomly selected sample of trees.

Trapping of gliders was conducted at both sites and this, coupled with extensive spotlighting, allowed the social organisation of gliders to be monitored. At Bombala, gliders lived in groups consisting of an adult pair and occasionally a sub-adult. Thus, glider groups almost always contained two or three individuals which shared an exclusive home-range. In contrast, glider groups at Kiola never contained fewer than three individuals and initially two groups contained six individuals each. Both these groups contained an adult male and at least two adult females, suggesting a polygamous mating system. Subsequently, group sizes declined to three individuals which included an adult pair with sub-adult. This decline in group size coincided with the failure of flowering in

methodology for socioecology study (section iii)  
 results for Bombala and Kiola

the most abundant tree species at this site, Eucalyptus Maculata, over three successive years. It is argued that the mating system of these gliders is determined by the abundance and continuity of their food resources. At Kiola, eucalypt blossom can be available throughout the year, providing a constant supply of both energy and protein.

Gliders at the two study sites gave birth to a single young. At Bombala, young were born predominantly between July and September while at Kiola, there was a predominance of births between February and March. This difference is suggested to be related to the timing of late lactation and weaning to coincide with the availability and predictability of certain food resources.

At both sites, glider groups occupied exclusive home-ranges. At Bombala, these averaged 55 ha (using 95C\*G isopleths based on the harmonic mean distance minimum) compared to 30 ha at Kiola. The difference in the size of the home range may reflect a greater abundance of food resources at Kiola. Exclusive use of a home-range is often considered suggestive of territorial behaviour. The gliding capability of these possums allowed extraordinary mobility within their home-ranges which is one prerequisite for territorial behaviour. I propose that the extensive use of vocalisations by yellow-bellied gliders, which parallels the behaviour of many primates, mediates this inter-group spacing. Calling rates by gliders were higher when they foraged in the periphery of their home-range compared to when they foraged in the core of their home-range. Experimental playback of vocalisations within glider home-ranges resulted in increased calling rates by the resident gliders and in 50% of tests, led to a resident glider moving into the playback area. These results suggest that the home-ranges of glider groups are in fact, territories.

This study shows that the extensive use of exudates by yellow-bellied gliders has a strong influence on their behavioural ecology. Exudates display a set of traits (a clumped spatial distribution, a continuous rate of renewal, can be quickly digested, have the potential to be available year-round and to be at times superabundant) which produce (i) an uncommon time-activity budget, (ii) a flexible mating system and (iii) apparent territoriality. Finally, the requirement of the yellow-bellied glider for very large home-ranges and the allocation of an enormous amount of time to foraging suggest that this species may be adversely affected by habitat alteration. Studies which examine the impact of logging on the behavioural ecology of this species are now required.

discussion of reproductive habits and their significance to study

results for study of home-ranges (section iv)

results for study of vocalisations (section v)

significance of findings

suggestions for further research

## Example from Commerce

Research on the implications of law for organisation theory in general and interorganisational relations (IOR) in particular **is** conspicuous by its neglect. The tendency **has been** to take the legal context as a unidimensional institutional given, ignoring the fact that there are many challenges to legislative efficacy. For this reason alone, theoretical and practical contributions by organisational scholars to important mainstream debates on regulation, deregulation and reregulation **have been** limited.

identifies a gap in knowledge in the research area

Notice the verb tenses used here

- **Is** –present tense used to indicate this is the situation **now**
- **Has been** and **Have Been** used to indicate that this has been the situation in the past.

The purpose of this study is to offer some redress to the situation by focusing on legally mandated IOR. Specifically, it **poses** and **seeks** to answer the following question: what are the implications of legally mandating IOR through public policy, with particular reference to occupational rehabilitation in New South Wales? Using Cranston's (1987) four phase process model of legislative efficacy, modified to account more fully for the compliance behaviour of the target population, a concept of partially mandated IOR is developed. This concept **attempts** to explain the differences and the interaction between mandated and voluntary IOR contingencies.

introduces the purpose of the study (the why stage of the abstract). Notice that the topic sentence of this paragraph is linked to the idea presented in the previous paragraph. This is called cohesion or 'flow', and is an important technique for clear writing.

introduces specific research question and indicates what model will be used to answer the research question (the 'how' stage of abstract)

Following a case study research design which allows for contextually embedded analysis employing multiple methods, the above model and concept, together with six theoretical propositions, **are examined** and subsequently validated in their application to legally mandated occupational rehabilitation. The largely historical analysis of mandate emergence **draws** attention to the need for interorganisational learning and adaptation to a complex uncertain and variable set of unenforced, self-regulatory circumstances. Content analysis of mandate form shows it to be vague, open-ended and partial in nature and reliant upon the authority of nonmandated organisations (insurers and treating doctors). Network analysis of mandate implementation is based on 81 interviews with 79 informants in 56 organisations which, except for the regulatory agency, are all situated in the Illawarra region of New South Wales. Agency-target IOR tended to be consultative, based on broadly unbridled target organisation discretion. Compliance behaviour was found to depend on voluntary incentives and the voluntary cooperation of the non mandated rather than through agency enforcement. Finally, the absence of objective mandate impact measures did not preclude the formation of positive views and experience largely attributed to successful interorganisational activities.

This paragraph builds on the previous one by outlining how the author answers the research question - what methods he uses.

more detailed information about the sample size, context etc of the study.

These findings draw attention to the need for IOR theory to acknowledge the partial nature of mandates, and for the public regulation literature to embrace IOR in policy formulation as well as implementation. In addition to identifying the potential utility of interorganisational collaboration in the management of IOR at a local, network and policy level, the study also proposes a number of future research directions based on the concept of partial mandates.

Here the author is indicating that his findings have identified a gap in the current research. The second sentence suggests areas for further research.