

The Road to Academic Success



McNair SCHOLARS PROGRAM

Journal of Research Reports

2005-2006 • Volume 11



WICHITA STATE
UNIVERSITY

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From the Director

I am proud to present volume 11 of the **Journal of Research Reports**, “*The Road to Academic Success.*” The articles featured in this journal represent the work of the Program participants from the 2005-2006-grant year. As one reads through these articles, it is clear that the breadth of research interests is as diverse as the students that we serve and the quality is outstanding as well. My staff and I could not be more pleased with the efforts that went into producing this meaningful and scholarly body of works.

The Program could not achieve such great accomplishments without the support of the University faculty, staff and administrators who have mentored students over the past eleven years. These mentors have not only guided the McNair Scholars in completing their research projects, but they have inspired them to unimaginable heights. All of the research mentors are to be applauded for their efforts in making undergraduate research a reality for the students in this Program.

Within this journal we will showcase the works of eight students who are McNair Scholars on the campus of Wichita State University.

A special word of thanks is directed to our Research Coordinator, **Mr. Bryan Flores**. His dedication to the Program and keen ability to motivate the students to produce the best possible document is greatly appreciated. Appreciation is also given to our Program Counselor, **Ms. Shukura Bakari-Cozart**, and the Senior Administrative Assistant, **Ms. Sheri Daniel**. Without their support and persistence in making sure that things get done in a timely manner, none of this would be possible year after year. These individuals are invaluable and irreplaceable. Dedication and commitment are rare qualities and I feel fortunate to have found staff members who are willing to go that extra mile.

Finally, I would like to congratulate the students for going beyond the classroom and putting their research interests into practice. Their efforts will not go unnoticed and will prove to be something they can be proud of for many years to come. We are most proud of our students and their accomplishments. This is a well-deserved accomplishment. These students are our future educators and the epitome of “Academic Success.” Thank you for the opportunity to work with such fine students.

LaWanda Holt-Fields, *Director*



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Enhancing Elementary Teacher Candidates' Understanding of Problem Posing and Problem Solving through an Inquiry-Oriented Mathematics Class

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McNair Scholar

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Abstract

his study investigates the strengths and challenges of problem posing and problem solving as a means to facilitate and deepen the conceptual understanding of some mathematics concepts among elementary teacher candidates. During this process, special attention was given to facilitating metacognitive-reflection strategies. Thirty pre-service teachers who were enrolled in two sections of the Mathematics Investigations course were provided tools to design a collection of problems on various levels of difficulty and to practice scaffolding (which comes first, which comes next in the teacher candidates' own understandings of sequencing problems by difficulty or by developmental appropriateness). The course models an investigative problem-based approach supported by apposite technology. Results indicated that within an environment conducive to successful problem solving and problem posing strategies and methods, pre-service elementary teachers might enhance the way they understand mathematics. Some candidates reported a recognition of the importance of inquiry based learning for diverse learners to deepen their understandings of mathematics.

Introduction

The National Council of Teachers of Mathematics (2000) proposed five process standards as essential in mathematics instruction. These standards are: Problem Solving, Reasoning and Proof, Communications, Connections, and Representation. Within these standards, problem solving is defined as "engaging in a task for which the solution is not known in advance" (NCTM, 2000, p. 334). This definition alone encompasses all the latter process standards when they are used to resolve a problem. A problem solver might, for example, explore, justify, use mathematical conjectures, and assess



the language of mathematics to discuss mathematical ideas clearly and concisely. He or she will then connect mathematical ideas and construct new mathematical ideas within and outside the realm of mathematics. Lastly, the problem solver will use models to apply and represent solutions in many forms, supporting conceptual understanding through multiple representations (NCTM, 2000). These process standards form a basis for the construction of this research.

The Problem

Many mathematic educators and researchers contend that current elementary mathematics instruction gives excessive focus on efficient computation and not nearly enough on conceptual understanding of mathematical ideas, problem solving, and reasoning (Alagic, 2003). Therefore, students do not receive a solid foundation of mathematics and are not deepening their mathematical understandings. This lack of problem solving and reasoning skills on the elementary level is creating an unstable foundation for students who reach higher levels of mathematics where reasoning is the expected focus — geometry, for example (Bell & Alagic, 2006).

Research implies that inquiry-based learning (which combines reasoning and action in a real-life application) is one solution to deepening the way students and teachers understand mathematics (Schon, 1992). According to Schon (1992), inquiry-based learning is the process of reasoning and posing problems (open-ended) in order to answer a more simple problem and, in turn, formulate a new problem—a process which results in a continuous cycle of problem posing and solving. This process fosters mathematical curiosity, an attribute desired in students by many teachers (Knuth, 2002).

However, while much attention is usually given to the process of problem solving, very little attention is given to a fundamental component of the problem solving process, *problem posing* (Knuth, 2002). In order for most students to fully understand mathematics and move through process standards at all levels, they must be able to pose problems and questions in order to construct (or make meaning of) mathematical knowledge that deepens their understanding of mathematics. This skill is not innate and must be modeled, practiced, kept up-to-date, and taught to students (Brown and Walker, 1990).

According to Roulet (2004) and Schifter (1998), teachers can move toward the use of inquiry based approaches when they have experienced learning through the same approaches. This requires the current teaching methods

of pre-service elementary teachers to be modified to incorporate inquiry based problem posing and problem solving techniques. Nonetheless, this movement alone is not sufficient in preparing teachers to teach students to deepen the way they understand mathematics by using inquiry-based approaches. Teachers must also focus on another component of the problem solving process, metacognition.

Metacognitive Process

Another underlying facet of problem solving is the ability to think about one's thinking (metacognition) and to reflect on the learning process in order to adjust or modify the strategies used to solve a problem (NCTM, 2000). Throughout the metacognitive reflective process, teachers and students alike are able to revisit their own thinking and ask themselves if their thinking makes sense. This, in turn, generates a cyclic progression of mathematical inquiry. During this process, one is able to judge whether or not there was an error in his or her train of thought and initiate a cyclic progression of problem solving.

This study is based in two sections of a mathematics investigation course for pre-service elementary teachers. It examines the use of problem posing and problem solving as a means to facilitate and deepen the conceptual understanding of some geometric concepts. Throughout this process, special attention is given to the metacognitive-reflective strategies that support critical thinking and generate further understanding of problem posing and problem solving.

Methodology

Participants

Thirty undergraduate pre-service elementary teachers who were enrolled in a sixteen week mathematics investigation course at a midwestern university volunteered to participate in a study that investigated progress in their abilities to problem pose and problem solve. The group consisted of 27 females and 3 males, all in their junior year of college, and all having at least one introductory elementary mathematics course at the collegiate level. All students were treated in accordance with the Wichita State University Institutional Review Board for the protection of human subjects.

Mathematics Investigation Course Description

Mathematics Investigation is an investigative, problem-based approach to mathematics focusing on the five process standards. The course guides pre-service teachers through problem solving and problem posing by providing tools for



students to design a collection of problems on various levels and practice scaffolding (the ability to sequence problems by the level of difficulty in order to evoke mathematical curiosity and deepen understanding). Secondly, it provides a means for collaboration and familiarizes the pre-service teachers with methods for teaching students to learn through inquiry and discovery. Lastly, it encourages and emphasizes reflection as a vehicle for deepening the students' mathematical understandings.

Course Components

Reading. In order to foster an understanding of the methods and expectations of the course, candidates were required to read about the five process standards (NCTM, 2000). Additional readings can be found at <http://www.education.wichita.edu/alagic/2005/319fall05/319.asp>.

Problem Sets. During the course, five problem sets were assigned to the teacher candidates. Each problem set required students to move through the process standards: Problem Solving, Reasoning and Proof, Communications, Connections and Representation. In doing so, students were expected to design a set of problems that focused on one mathematical concept — volume, exponential growth and decay, triangle properties, Pascal's Triangle, or fractions. The requirements for completing a problem set were that the problems must be open-ended, related to real life, and challenging (relative to a secondary learner). In addition, each problem set was to consist of five to seven additional problems that scaffold down the central concept (the same concept is challenged and broken down to levels K-8 from a more difficult problem on a secondary level). The result exhibits the ongoing development of a selected concept through a series of word problems (Alagic, 2006 a, b). All problem sets contained a two-column solution (steps and justification).

It was also required that each of the problem sets incorporate within it at least one component of technology and have a central focus on reflection. Students were expected to use interactive electronic tools — spreadsheets, graphics, and other means — to clearly communicate and explain each concept at every stage of the scaffolding process. Lastly, students were expected to write a reflection at the end of each problem set expressing what was learned about the concept, what challenges were faced, and any insights, regrets, or other information that seemed pertinent to the process of completing the problem set.

Reflections. In addition to the reflective component at the end of the problem sets, students were required to participate in a virtual collaborative group and submit

reflections and comments online. Student groups consisted of approximately four students. Their reflections were based on certain questions that supported current classroom activities. Students in these groups also wrote a weekly group summary on a rotating basis which was brought to class for open discussion.

Data Collection Strategies

This research revolves around two-course components: problem sets and reflections. The problem sets were scored on a rubric based on the quality and inclusion of the challenge problem (20%), scaffolding problems (20%), solutions (20%), vocabulary (10%), references (5%), and metacognitive reflection (15%). All problem sets were submitted in electronic form, and scoring was returned in the same manner. These scores were recorded and used in measuring the teacher candidates' progress. Progress was also monitored through the component of online reflections. Individuals within groups reported what they learned and their understanding of the concepts such as scaffolding, problem solving, problem posing, and reflection. The individual response groups discussed their thoughts and then later brought these thoughts to class.

Results

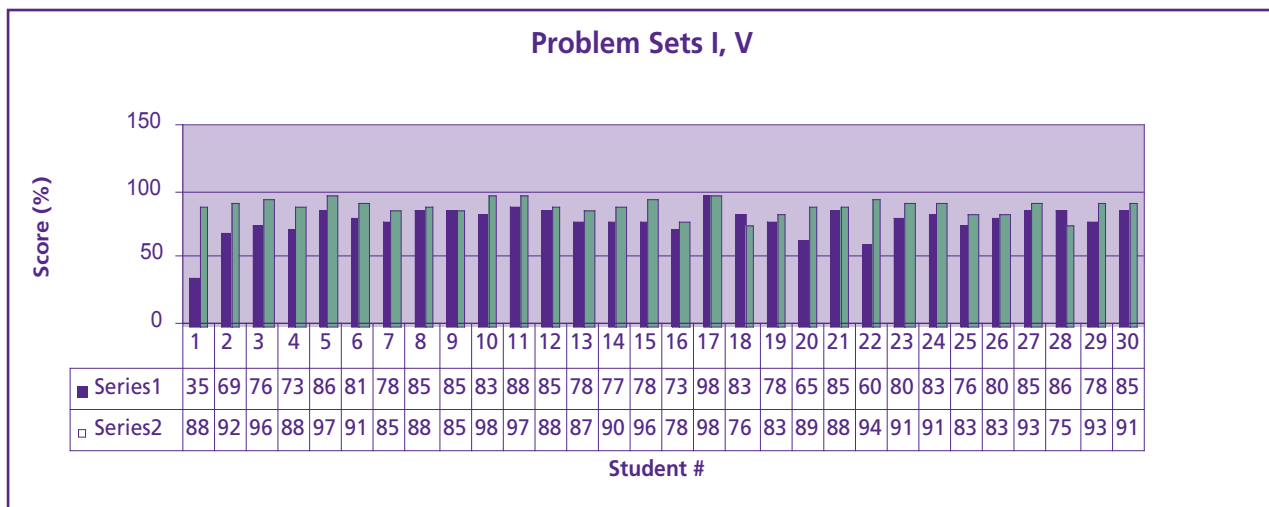
As previously stated, progress in mathematical problem posing and problem solving is determined in two ways: 1. Self-report from student reflections, and 2. Problem sets graded on a rubric (see <http://www.education.wichita.edu/alagic/2005/319fall05/319.asp>). In general, students tended to pose better problems after completing the first problem set and receiving instruction and information concerning inquiry based learning. Namely, twenty-six of the thirty who completed all problem sets improved their scores; two remained constant and two scores showed losses. The chart below records each candidate's progress on the first and last problem sets respectively.

On the first problem set, 63% of the candidates expressed difficulty in posing an open-ended problem and being able to word the problem so that it made sense. Statements from the teacher candidates included,

- "I have just begun to develop my skills in scaffolding an idea and need more experience in working with this idea..."
- "I struggled through the initial problem set..."
- "This set was very difficult to complete...I do think it is interesting how the problems can be developed in steps, up to a more difficult question. I understand the



Table I



benefits of using a scaffold, but I am not sure that I did it correctly.”

- “...it is extremely difficult to create problems. Story-type problems have always been a problem of mine, and the difficulty I experienced while creating these was not surprising.”

Of these candidates, 37% reported that this difficulty was fueled by math anxiety, 16% described difficulties making connections in scaffolding, 16% struggled with making justifications, 16% conveyed confusion about expectations and executions, and 15% simply stated difficulty without causation.

Nevertheless, as more instruction, written feedback on the problem sets, and reflective collaboration took place, candidates started to perform better on problem sets (as illustrated in the chart above) and 90% confidently expressed the knowledge of improvement even before receiving scores on the problem sets.

- “The largest place in which I have made improvement is in the scaffolding skills...efficiently scaffolding concepts from a simple step to a thoroughly involved open-ended question...”
- “I tried to apply all the lessons I learned in making my previous problem sets...as my knowledge of scaffolding and open-ended problems increased, the problem sets became easier to complete.”

Eventually, some candidates began to see how what they were doing in class could relate to the classroom and the learning of diverse students.

- “For the student who might not just get numbers and formulas, the real life situations can help them get a picture of the problem.”

- “The earlier problems...presented used manipulatives so the child can be hands on and get the clearest picture.”

Evidence shows that pre-service teachers were learning and progressing in the ability to pose problems in such a way that creates inquiry and mathematical curiosity through scaffolding.

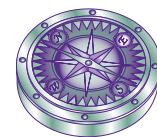
Discussion of Findings

Problem Set I

The first problem set asked the candidates to pose open-ended problems that are real-life oriented and have significant mathematical ideas related to the concept of volume. Prior to giving this assignment, the teacher candidates discussed and read about scaffolding, open-ended versus closed problems, and problem solving in the context of the process standards integration. This first set for many pre-service teachers presented a major challenge. Issues of mathematic performance anxiety surfaced within metacognitive reflections included in their problem sets. Posing problems was another clear challenge for many.

- “This has been difficult in that mainly the wording and the semantics of the challenge problem have given me trouble...”

Many candidates relied heavily on Internet resources without enough critical intellectual involvement to accommodate the problem set requirements. Solutions did not have the necessary detail, although a large portion of class time was devoted to the discussion and modeling of reasoning and proof as well as other relevant mathematical processes/standards. In some sets, it was not always clear what the candidates were trying to communicate. Part of the reason for this was that some pre-service teachers were leaving



out important definitions or posing written problems where the problem became confusing due to grammatical errors.

Subsequent Problem Sets

In subsequent problem sets, candidates seemed to deviate from relying intensely on Internet resources when they felt they were already familiar with the concept at hand. Candidates generally stated that it was easier to make problem sets and scaffold when the concept/topic was familiar to them and expressed extreme difficulty when their interaction with the concept prior to this class was non-existent or faintly recalled. In fact, on the third problem set, candidates' scores were considerably higher. This might imply that students had greater prior knowledge of triangles and experience with the Pythagorean Theorem, and/or that the practice of problem posing and problem solving enabled them to break through this challenge one step at a time.

Problem Set V

By the last problem set, candidates were well acquainted with the routine of problem sets and had the opportunity to improve mathematical reasoning and the ability to write justifications. Overall, it seemed that candidates were very familiar with fractions and therefore thought it easier to complete this problem set. It is apparent that the more familiar the pre-service teacher is with a concept, the better he/she is able to scaffold down the problem. Approximately 87% of the candidates improved their scores from the first problem set to the final problem set. Those students who did not make gains (two remained constant and two experienced losses) seemed to either have scored extremely high on the first problem set and maintained their scores or failed to complete a section (reflective component) due to possible time constraints. Other possibilities include candidate deviations from the proposed problem set topic to other related topics inadvertently. For example, while the fifth problem set focused on fractions, a candidate might have chosen to use decimals. While decimals are another form of fractions, this representation does not show comprehension in how to deal with fractions unless the conversion is expressly stated.

The candidates seemed to make the most progress on problem sets that focused on concepts with which they were very familiar. They struggled most with justifications and connecting scaffolding questions without deviating from the central concept. Anxiety from previous mathematics courses also appeared to play a devastating role in how candidates approached problem sets. Therefore, confidence was an

underlying determinant of each candidate's performance on each problem set.

Conclusion

This study appears to demonstrate that most of the teacher candidates experienced growth in learning to use inquiry based techniques to broaden their own understandings of mathematics. Candidates reported that they learned more about topics with which they were unfamiliar and understood better topics with which they possessed a wealth of knowledge. Candidates also reported anxiety toward mathematics, word problems, and reasoning; this perpetuated a reliance on virtual tools and explanations of problems rather than the teacher candidates actually delving into the problems on a more critical level.

Further research might include a focus on concepts with which the teacher candidates report unfamiliarity and on measuring their growth in conceptual understanding. Researchers might also explore a way to reduce candidate reliance upon virtual tools rather than delving deeper into the concept at hand — perhaps the candidates were fascinated with the tools and thereby became distracted from the actual problems. Finally, one can investigate how to reduce math anxiety in the candidates before assigning a particular task.

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Changes in Heart Rate May Be a Vital Indicator to Poor Lifting Mechanics

Crishel Kline

McNair Scholar

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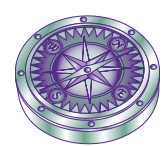
Wichita State University

ABSTRACT

Changes in heart rate (HR) may be a vital indicator of poor lifting mechanics in the healthy college-aged individual. It was hypothesized that poor lifting mechanics would trigger Valsalva maneuver (VM) causing a significant increase in HR and blood pressure (BP). **Method:** The use of an electrocardiogram (ECG) machine during the activity of lifting can be a reliable means of assessing poor lifting mechanics. Individuals had physiological parameters assessed during a functional movement while lifting objects weighing ~50% of their bodyweights. An ECG test was conducted during the study. Participants performed the movement with no instruction during Trial 1 and with proper lifting technique and breathing instruction prior to Trial 2. Monitoring continued and was carefully observed throughout the lifting movement to record any changes that occurred during the functional activity. **Results:** Statistical analyses were run on absolute HR values, and significance was observed between Stages 1-3 of the lift when comparing Trials 1 and 2 (100.2 ± 19.1 vs. 105.1 ± 21.4 ; 98.1 ± 16.3 vs. 105.2 ± 19.8 ; 97.1 ± 16.7 vs. 105.7 ± 18.9 , respectively). **Conclusion:** VM can occur regardless of the amount of weight lifted, and incorrect lifting mechanics may be the trigger for this response.

INTRODUCTION

Valsalva maneuver (VM) is a potentially dangerous mechanism that is characterized by an increase in systolic and diastolic blood pressure caused by a reduction in venous return to the heart (Howley & Franks, 1997). During resistance exercise (RE), VM is commonly triggered because the maneuver creates an internal pressure which aids in the ability to lift heavy objects. While performing the mechanism an individual inadvertently does so with



a closed glottis (the opening between the vocal cords at the upper part of the larynx). Valsalva maneuver and its responses to exercise and exertion have been studied in many scientific disciplines to assess its physiological effects. Researchers have been able to document increases in blood pressure (BP) during forms of heavy RE and even in lighter RE when performed to fatigue (MacDougall, McKelvie, Moroz, Sale, McCartney, and Buick, 1992).

O’Conner, Sforzo, and Frye (1989) reported that breathing instruction to avoid VM aided in the stabilization of systolic blood pressure (SBP) while instruction to perform VM resulted in a significantly higher SBP. Participants who received no instruction showed no significant change in SBP throughout the study (O’Conner, Sforzo, & Frye, 1989). Similarly, Narloch and Brandstater (1995) discovered that BP increased significantly when VM was utilized as a breathing technique when resting and when lifting 85% and 100% maximal lifts on an isotonic leg press. When slow exhalation was performed among the participants, the significant rise in BP observed while performing VM was not present (Narloch & Brandstater, 1995), conclusively indicating that lifting heavy weight is safer when done with an open glottis and avoiding VM.

In an effort to determine the effect of performing heavy weightlifting and static contractions on BP, MacDougall et al. (1992) discovered that participants in their study did not find it necessary to employ VM unless the required force output exceeded ~80% of their maximal lift during heavy RE. These same researchers observed that the participants using lighter loads practiced VM as they continued to perform repetitions to failure. In fact, the incidence of using VM increased as the participants neared failure (MacDougall et al.). This suggests that VM may be triggered during light lifting as well as heavy.

When examining whether a distinction could be made between trained and untrained individuals, Fuenmayor, Fuenmayor, Winterdaal, and Londono (1992) concluded that differences in the two groups were found only when VM was used as a breathing technique. The results of this study suggest that VM had the same effect on both trained and untrained individuals’ systolic arterial pressures and heart rate (HR) responses to VM.

Changes have also been documented in ventricular function due to VM which may affect changes in HR or even heart rhythm (Fuenmayor et al., 1992), but a consensus on the specific cardiac adaptations during heavy lifting has yet to be made. Therefore, this study uses an electrocardiogram (ECG) machine to assess electrical

cardiac changes throughout a heavy lift with and without a triggered VM.

HYPOTHESES

1. Lifting a heavy object with poor lifting mechanics initiates a closed glottis triggering an increase in internal abdominal pressure (VM).
2. The increased internal abdominal pressure (VM) causes changes in electrical activity of the heart.
3. Proper instruction on breathing technique and lifting mechanics prevents the initiation of VM.

The objective of the present study was to determine whether changes in HR due to the use of VM could predict poor lifting mechanics.

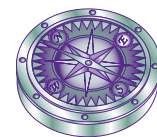
METHODS

Participants. Twenty-nine healthy, college-aged participants (mean age = 22.31 ± 1.61) volunteered to participate in this study. All participants signed an informed consent and completed a Physical Activity Readiness Questionnaire (PAR-Q) prior to taking part in this study. Participants were then asked a series of questions from a Participant Information Chart developed by the researchers to determine background information such as age, height, dominant hand, number of days spent exercising per week (0-7), and if he or she had any previous injuries (low back, knee, and/or other). Other items on the chart that were determined or assessed by the researchers included gender, weight of the participant, total weight used for the lifting exercise, weight used per hand for the lifting exercise, and the six stages which determined HR in Trial 1 and Trial 2 (see Table 1).

Table 1. Descriptive characteristics of the 29 participants who completed lifting testing.

Mean ± SD. BMI = body mass index.

Participants (n=29)	Characteristics
Age, yrs	22.3 ± 1.6
Male / Female	8 / 21
Height (cm)	170.5 ± 9.8
Weight (kg)	70.5 ± 16.5
BMI (kg/m2)	24.0 ± 3.7
Lifting	
Total weight lifted (kg)	33.9 ± 5.1
Weight in dominant hand (kg)	14.3 ± 4.0
Weight in non-dominant hand (kg)	20.0 ± 1.4



ECG and HR. Participants' resting HR levels were assessed using a 12-Lead ECG machine (Q4500 Quinton, Seattle, WA). Ten electrodes were placed on the participants' chests to record the electrical activity of their hearts. Participants were monitored and carefully observed through the lifting movement to record any changes that occurred during the functional activity. Changes in HR were assessed by measuring the distance between R spikes on an ECG tracing. Six stages of HR were recorded during the lift and reported on a Participant Information Chart.

Functional Lifting Objects. Dumbbells (Personal Power Block, PowerBlock, Owatonna, MN.), which are adjustable in 2.3 kg (5 lbs.) increments from 2.3 kg to 20.4 kg (5 lbs. to 45 lbs.) per block, were used to simulate a functional lifting maneuver by each participant while he or she was connected to the ECG machine. The body weight of the participant was measured and recorded; fifty percent of this value was determined to be the total lifting weight. Weight was not dispersed evenly between dominant and non-dominant hands. Without the participant's prior knowledge, the lifting weight was preset to 20.5 kg (45 lbs) for the non-dominant hand. The remaining weight was then adjusted for the dominant hand to total fifty percent of the participant's weight. If the participant weighed more than 81.9 kg (180 lbs), he or she lifted 20.5 kg (45 lbs) in both hands.

Trial One and Trial Two. Participants in this study completed two trials. Trial 1 and Trial 2 were run consecutively. Before Trial 1 began, participants were given minimal instruction. Participants were instructed to lift the objects at their sides until a standing position was achieved and then to return the objects to their original positions. Before Trial 2 began, participants were given detailed instruction on breathing technique and proper lifting mechanics. Participants were asked to lift these objects as if they were functional items such as a briefcase or a suitcase in both Trial 1 and Trial 2. Trial 1 and Trial 2 consisted of six stages during which the participant's ECG trace was assessed for changes in HR.

Six Stages of HR.

Stage one: (HR 1) Standing (resting) HR was assessed.

Stage two: (HR 2) Participants bent down and lifted the determined weight.

Stage three: (HR 3) Participants stood with the determined weight.

Stage four: (HR 4) Participants returned the weight to original position.

Stage five: (HR 5) Participants stood to an upright position.

Stage six: (HR 6) Standing post-trial (recovery) HR.

Statistical Analyses. Heart rate data from a 12-Lead ECG during the six stages of lifting were compared for Trial 1 and Trial 2, where applicable, using one-way ANOVA with repeated measures. Tukey's *post hoc* test was implemented where appropriate. Consistency of values within cases is presented using calculation of the intra-class correlation coefficient for each variable (ICC). The statistical analyses were performed using SPSS (version 12.0; SPSS Inc. Headquarters, Chicago, Illinois, U.S.). Data is expressed as mean \pm SD and the level of significance was set at $p < 0.05$ for all variables.

RESULTS

There were statistical differences reported between Stages 1 through 3 when absolute HR values of Trial 1 and Trial 2 were compared ($p < 0.05$) (see figure 1). In addition, percent change in HR for lifting Stages 2 - 6 were compared to the initial HR in Stage 1 and results showed a significant change in mean HR during Trial 1 (lifting without instruction) ($p < 0.05$), while there was no change in Trial 2 (lifting with instruction) (see Figure 2). The absence of proper lifting mechanics instruction and breathing technique instruction in Trial 1 dramatically increased VM induced HR increases in the participants.

Table 2. Changes in HR through the six stages of heavy lifting without instruction (Trial 1) and with instruction (Trial 2) for the 29 participants. Units for HR are beats min^{-1} .

	HR 1	HR 2	HR 3	HR 4	HR 5	HR 6
Trial 1	100.2 \pm 19.1	98.1 \pm 16.3	97.1 \pm 16.7	104.7 \pm 20.3	104.3 \pm 17.3	110.1 \pm 14.4
Trial 2	105.1 \pm 21.4	105.2 \pm 19.8	105.7 \pm 18.9	106.1 \pm 18.4	105.5 \pm 19.0	109.3 \pm 13.6
ICC	0.95	0.93	0.92	0.99	0.99	0.99

DISCUSSION

Lifting objects, and in some instances awkwardly heavy items, is an important function of most individual's daily lives. According to the American Council on Exercise (ACE), poor lifting mechanics cause excessive stress and subsequent injury to the lower back contributing to low back pain (1997). Poor lifting mechanics are difficult to observe because many of the physiological changes that occur during lifting are internal. Recent publications agree that a primary preventative measure is proper strength conditioning to the affected region (Howley & Franks,



Figure 1. Absolute HR values: Trial 1 and Trial 2. Statistical significance (*) indicated in Stages 1-3.

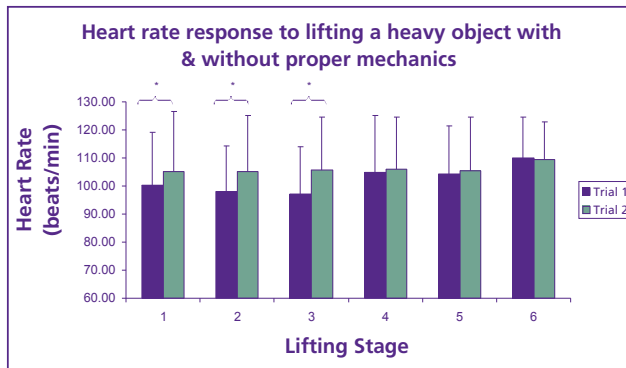
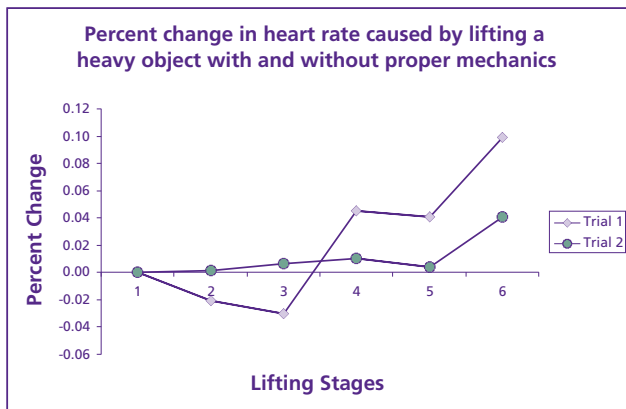


Figure 2. Percent of change in absolute HR values Stages 1-6, Trial 1 (without instruction) and Trial 2 (with instruction).



2003). Thus, one of the preventative measures is also one of the leading causes of injury, making it important to identify and correct poor lifting mechanics before an injury ensues.

Correct lifting mechanics include keeping the lower back in the normal arched position, getting as close to the load as possible, avoiding twisting motions by sidestepping, keeping stomach muscles contracted, placing feet in a position that provides a wide base of support, and keeping the head and shoulders upright (McGill, 2001). Even by closely following these instructions, changes in hemodynamics occur during the lift and the additional instruction on correct breathing becomes important.

Valsalva maneuver during lifting is a natural occurrence in poor lifting mechanics because it increases the pressure within the abdominal cavity (as discussed below) and takes stress off the spine. However, abdominal core muscles (internal and external obliques and the transverse abdominus) should activate this central stability. During lifting, BP increases are variable and can cause significant

physiological changes (Hill, 1991). Direct intra-arterial recordings of BP (Narloch, 1995) have shown that BP changes variably during the concentric and eccentric phase of a lifting exercise and that the significance of the BP response increases with each successive repetition.

The objective of this study was to assess the effects of correct and poor lifting mechanics on HR and determine if an ECG recording during the movement could be used to identify poor lifting mechanics. Our results suggest that the changes seen in HR due to VM may indicate poor lifting mechanics. However, when the percentages of change in HR through both lifts were assessed, no significance was shown (.097). Nonetheless, a trend was observed. There were notable differences in HR when comparing the percent change between Trial 1 and Trial 2 during the first five stages of the lift.

The physiological changes that occur during VM are triggered by the closing of one's glottis to trap inhaled air within the lungs creating an increase in intrathoracic pressure. The rising pressure compresses veins reducing blood flow returning to the heart. This causes arterial blood pressure to drop, reducing the normal blood supply to the brain and can cause dizziness, spots before the eyes, and even fainting with straining-type exercises (McArdle, 1991). When the glottis is re-opened, the intrathoracic pressure is released and venous return is established once again. These physiological changes that occur as a result of VM are split into four distinguishable phases (see Figure 3):

- Phase 1:** Begins with the onset of exertion and is marked by an increase in both systolic and diastolic blood pressure and a decrease in HR.
- Phase 2:** Begins as stroke volume and BP both decrease significantly due to a reduction in venous return and HR begins to increase.
- Phase 3:** Begins immediately as exertion is discontinued. Venous flow is no longer restricted, and the heart is immediately filled with blood. Arterial pressure drops and HR increases significantly.
- Phase 4:** Referred to as the "overshoot" Phase due to an increase in BP (and a decrease in HR) that continues for three to eight seconds (Narloch & Bandstater, 1995).

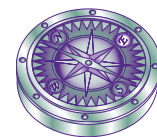
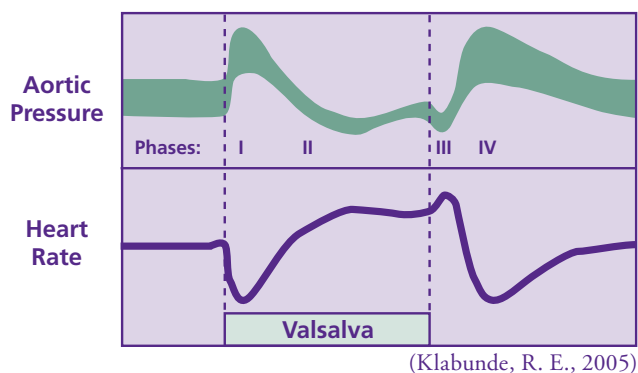


Figure 3. Aortic pressure and heart rate response to Valsalva maneuver.



As displayed in Figure 2, results from Trial 1 show a similar HR response as the phases just discussed. Heart rate measures 1, 2, and 3, in Table 2 and Figure 1 represent Phase 1 of VM; Phase 2 occurs between HR measures 3, 4, and 5 while Phase 3 is indicated by HR 6. As lifting began (Phase 1), a drop in HR was recorded (100.2 ± 19.1 to 97.1 ± 16.7 b/min-1). Phase 2 was indicated in this study by HR 3, 4, and 5 where there was a distinguishable increase in HR (97.1 ± 16.7 to 104.3 ± 17.3 b/min-1). Heart rate 6 denotes Phase 3 (110.1 ± 14.4 b/min-1). Unfortunately, Phase 4 was not documented because the ECG trace recordings were stopped at the end of the lift and subsequently before Phase 4 could occur.

When breathing and lifting instruction were provided before the lift in Trial 2, HR showed no change in Phases 1, 2, and 3, indicating VM was avoided. Again, it is likely that Phase 4 was not observed because the recording of the ECG stopped too soon. Although the lift was finished, the effect of VM continued through recovery, which was not assessed in this study.

As suggested by MacDougall et al. (1992), VM may not be initiated unless the lifting weight is at or above eighty percent of one's maximal lift. However, weights used in this study were limited to 41 kg (90 lbs) and the actual weight lifted was approximately fifty percent of the participant's body weight. Although the maximal lifting weight for each participant was not measured, it is likely that the weight lifted did not exceed eighty percent, yet still showed hemodynamic changes. This may indicate that the phases of VM can occur regardless of the amount of weight lifted and that poor lifting mechanics may be the trigger for this response. However, lifting a heavier weight may provide a greater change in HR, resulting in a greater change in pressure and a more significant chance of triggering VM. Further investigation into this matter is necessary.

Consecutively run trials appeared to have affected HR in Trial 2, suggesting that fatigue occurred from Trial 1 and a longer recovery between trials may be necessary. It is not clear to what extent VM affected HR since pressure changes were not measured. Assessments made by a catheter may be a more reliable method to assess the effect that poor lifting mechanics have on HR; however, the method used in this study was non-invasive and took little time to set up. With further evaluation, the use of ECG monitoring during lifting can be a practical and cost-effective means of assessing and instructing lifting mechanics.

CONCLUSION

Although no significance was observed when examining the percentage of change in HR between Trial 1 and Trial 2, significance was found when comparing absolute HR values in Stages 1 through 3 of the lift. This is important considering these are the stages when VM is most likely to occur while lifting. Furthermore, our results suggest that VM may be triggered regardless of the amount of weight lifted if not using proper lifting mechanics. To better predict the physiological changes that occur during functional activities, further research using more invasive means may be necessary.

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Conduct Problems: Covert Sequence

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E

Abstract

Early conduct problems can involve overt behavior such as hitting and teasing or covert behaviors such as lying and stealing. Very little research has examined covert conduct problems in early childhood. Covert behavior in early childhood is predicted to occur in a specified sequence. This study examined the appearance of covert behaviors such as not showing guilt, lying, cheating, or stealing in 255 children ages five and six. The study found that early covert conduct problems occur in a specific, not a random, sequence. The majority of participants in the study follow the expected sequence patterns.

The data available on the developmental progression of conduct problems in early childhood is far from immense; however, a number of researchers have indicated the role of early-onset conduct problems in the development of chronic antisocial behavior (Willoughby, Kupersmidt, and Bryant, 2001). Two processes have been identified that contribute to this progression: coercive interaction among peers and selective affiliation with deviant peers (Snyder et al., 2005). The latter occurs during the elementary school years when monitoring by adults decreases and the array of peers with whom to interact increases (Snyder et al., 2005). One of the risks for the development of early onset conduct problems, such as those identified as overt and covert behaviors, arises as the result of this increased opportunity for exposure and interaction with other children of similar age. Peer-to-peer contact across social settings includes intervals of time spent in daycare, preschool, or kindergarten which are rich in opportunities for children to acquire social skills from same-age peers or to acquire deviant values and behavior (Snyder, 2002). Deviant talk and role taking imitation have been found to double in rate of occurrence during kindergarten (Snyder et al. 2005).



Additionally, Patterson (2002) identified coercive interactions with mothers or other caregivers with infants as the initial exposure and ecological setting where aversive behavior like crying gains a utility by which an infant may get its needs met. Then, as Patterson's theory postulates, coercion becomes a mechanism between mothers and infants that is subsequently positively and negatively reinforced in a reciprocal interchange. These forms of coercive interactions may later proceed to temper tantrums, fighting, and stealing, behaviors that have been identified by Loeber (1985) in the covert and overt developmental trajectories.

Not all children are at risk for developing conduct problems; however, the populations of children who exhibit early conduct problems in the form of covert behaviors are the target group of this study. These types of conduct problems may create long-term, negative consequences for children and for families because they are likely to impede the formation of prosocial skills (Reid et al. 2002), and to serve as a direct precursor for problems such as truancy, early sexual behavior, clandestine drug use, dropping out of school, and covert conduct problems that create long term negative consequences.

Overt conduct problems, which are readily apparent and normally observable, are considered to be direct acts of noncompliance and aggression. The developmental trajectory for overt behavior (Loeber & Schmalting, 1985) places fighting and various other forms of aggression at one end of the spectrum. Fighting appears very early in childhood and then has the tendency to decrease in frequency as children get older (Loeber, 1998; Snyder, Cramer, Afrank, & Patterson, 2005). Covert conduct problems are more problematic and increase with age.

Researchers have concluded that while overt antisocial behaviors involve confrontations with others, covert antisocial behaviors purposefully avoid confrontation (Willoughby, Kupersmidt, and Bryant, 2001). Covert behavior is less distinguishable due to its purposefully discreet nature and involves acts such as stealing, cheating and lying. Accordingly, Stouthamer-Loeber, and Loeber (1986) and other researchers have suggested that lying is one of the earliest concealing behaviors to develop in the repertoire of conduct problem children. As a result, covert behaviors without intervention may persist and increase in frequency (Snyder et al. 2003). Little is known about the prevalence or developmental phenomenology of covert conduct problems. The present study hypothesized that covert conduct problems, when they do occur, would manifest themselves in a systematic order, rather than in a random pattern or sequence.

Method

Data was collected from parent reports on 255 children who were observed on multiple occasions. These 133 girls and 134 boys were between the ages of five and six years old. The school from which the sample was drawn was located in a low socio-economic neighborhood. The participating children were from a racially diverse population, and the medium per capita income for families was \$8,300 (Snyder et al., 2003).

Measures

Six items from the Child Behavior Checklist (Achenbach & Rescoria, 2001) were utilized to test the hypothesis that covert behaviors occur in the following sequence: lack of guilt, secrecy, lying or cheating, stealing, vandalism, and fire setting. Data about the problematic occurrence of each of these six covert behaviors were gathered from parent reports at the beginning of the kindergarten fall semester.

Results

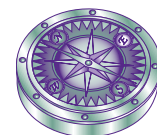
An expected probability distribution was formulated as shown in Table 1 to indicate how the covert behaviors of all 255 participants would be randomly distributed across all 64 sequence patterns from the Child Behavior Checklist. Each of the 64 possible sequences would occur at an expected frequency = 3.98. Support for the hypothesized sequence can then be estimated by comparing the observed frequency of sequences to the random distribution shown in Table 1.

Table 1
Random Sequence of Covert Behavior Problems from Child Behavior Checklist

Lack of Guilt	Secretive	Lie/Cheat	Steal	Vandalism	Set Fires	Frequency
0	0	0	0	0	0	3.98
1	0	0	0	0	0	3.98
1	1	0	0	0	0	3.98
1	1	1	0	0	0	3.98
1	1	1	1	0	0	3.98
1	1	1	1	1	0	3.98
1	1	1	1	1	1	3.98

(57 other Sequences not Shown each = 3.98)

A total of ninety-six children did not display any covert behaviors from the hypothesized sequence pattern: not guilty, followed by secretive, lying or cheating, stealing, vandalism, or setting fires (top line Table 2). Of the remaining fifty-one children, thirty children demonstrated



the not guilty variable and no other covert behaviors (second line Table 2). A total of six children were observed to demonstrate the not guilty variable followed by the secrecy covert behavior variable and no other covert behaviors (third line Table 2). Of the remaining children, ten participants fit the not guilty variable followed by secretive, lying and cheating variables (fourth line Table 2). Only three children were observed to do the all of the previously listed variables in the hypothesized sequence pattern adding onto that pattern the stealing behavior variable (fifth line Table 2). Two children were observed to fit into the pattern adding vandalism to all of the previous variables (sixth line Table 2). There were no children observed in this particular age demographic who followed the hypothesized sequence to setting fires (last line Table 2).

Table 2
Frequency Pattern Observed

Not Guilty	Secretive	Lie/Cheat	Steal	Vandalism	Set Fires	Frequency N = 255
N	N	N	N	N	N	96
Y	N	N	N	N	N	30
Y	Y	N	N	N	N	6
Y	Y	Y	N	N	N	10
Y	Y	Y	Y	N	N	3
Y	Y	Y	Y	Y	N	2
Y	Y	Y	Y	Y	Y	0

The actual probability distribution derived from our measurements indicated that 147 of the 255 children fit the hypothesized sequence at a frequency = 21.00 per sequence (compared to the expected mean frequency of 3.98). A Chi Square test was calculated to compare the observed frequencies to the expected frequency. The observed distribution was different from the one hypothesized to occur by chance: $X^2(1, N = 255) = 568.13, p < .05$.

A few distinct patterns, which did not fit the expected sequence, occurred quite often, typically involving variation in the appearance of the first three types of covert behavior in the hypothesized sequence. Therefore, the data were collapsed across these three variables, which were compiled into one category. The following variables—not guilty, secretive, lying or cheating—counted as the initial step in the sequence, followed by the remaining sequenced variables of stealing, vandalism, or fire setting (see Table 3). This yielded an interesting outcome. After collapsing the data, a total of ninety-six children displayed none of the covert behaviors compromising the sequence (top line Table 3).

However 124 children were observed to fit the collapsed not guilty, secretive, lie or cheat variable and no other covert problems (line 2 Table 3). A total of 24 children followed this identical sequence pattern adding on the stealing variable (line 3), and three children followed this sequence frequency pattern plus added the vandalism variable (line 4). Therefore, the collapsing measure yielded stronger results with 97% of the participants fitting the hypothesized covert sequence (see Table 3).

Table 3
Frequency Pattern Child Behavior Checklist Collapsed

No Guilt/ Secretive/ Lie or Cheat	Steal	Vandalism	Fire Start	Frequency n=255
N	N	N	N	96
Y	N	N	N	124
Y	Y	N	N	24
Y	Y	Y	N	3
Y	Y	Y	Y	0

A Chi Square test comparing the observed mean sequence frequency of 49.4 with the expected mean sequence frequency of 15.94 for each sequence given equal likelihood, revealed that the observed sequences occurred more often than expected by chance: $X^2(1, N = 255) = 85.2, p < .0001$.

Discussion

The implications of the current study are twofold. First, the predicted sequence patterns of covert behavior were observed. Evidence indicated that 58% of the children in the study followed the predicted sequence pattern of covert behaviors from the Child Behavior Checklist. The remaining 42% of the children, however, clearly indicate there is a need for additional research to gain a further understanding of the developmental dynamics occurring in children who don't fit the predicted sequence: not guilty, secretive, lying or cheating, stealing, vandalism, or setting fires. The current study suggests the indicators of covert behavior from the Child Behavior Checklist do not always occur in a sequence that we expect to see in children five and six years of age. It appears that lack guilt, secretive and lying or cheating behaviors are interchangeable in that sequence. Therefore future studies may benefit from the development of sequence patterns that capture the covert behavior patterns of very young children. This would enable parents and other caregivers to know what to look for and



when early intervention with treatments that have been empirically validated and proven efficacious in treating conduct disorders.

Due to their discreet and clandestine nature, covert conduct problems tend to be like icebergs. What the observer sees above the water may appear normal, but it often belies a bigger problem. Counselors, parents, teachers, or psychologists would benefit from the development of measures to aid in the early detection, intervention, and prevention of covert behaviors.

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The Role of Copulatory Behavior within the Social Structure in Bachelor Groups of Captive Western Lowland Gorillas

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M

Abstract

Modern zoological parks that house western lowland gorilla populations prefer to accommodate single-male/multi-female groups which include their sexually immature young. The result is an excess of adolescent, sub-adult, and adult bachelor male gorillas that must be housed and displayed collectively. Due to the increase of gorilla bachelor groups in the zoological community, the social structures of these all-male groups are more accessible to research. This observational study focuses on copulatory behavior within these groups and its role in the current hierarchical relationships among the group's members. Observations were conducted at the Sedgwick County Zoo in Wichita, Kansas. The Sedgwick County Zoo has eight male gorillas in three separate groups; two groups of two silverback males, and one group of four sub-adult/adolescent males. Only the group of four was observed for this study. Observations occurred over fifteen non-consecutive days and were three hours in length during mornings and early afternoons. The observational method used was group-scan sampling every five minutes with documentation of affiliative behavior within two meters or less. The social order within this group is complex and varies between dyads of individuals and the group of four. The rank of an individual was estimated by size, age, and displacement frequencies. This study suggests that sexual activity within this bachelor group may be integral to the greater social bonding dynamic.

The Role of Copulatory Behavior within the Social Structure in Bachelor Groups of Captive Western Lowland Gorillas

To date, there have been at least 450 species of animals, vertebrates and invertebrates, which have been acknowledged as exhibiting homosexual behaviors (MacFarlane and Markwell 2004). The most studied animals that



exhibit these behaviors are the pygmy chimpanzees, or bonobos. These animals have a complex social structure, and the sexual act has a purpose beyond reproduction (Kuroda 1980; Parish 1994). Chimpanzee and gorilla sexual behaviors may give us insight into the sexual motivations of other animals.

Until the 1980's, the most pressing problem zoos encountered regarding the care of gorillas was the difficulty of breeding them in captivity. Today, the number of captive gorilla births has greatly increased due to improved diets, enrichment activities and improved enclosures. Recently, there have been a greater number of male gorillas born in captivity than females. Zoos prefer to house single-male/multi-female family groups that include one silverback, many females, and their sexually immature young. When young males move into sexual maturity, they become competition for the silverback, and conflicts between males arise (Symington 1993). For the protection of the young gorillas, they are removed from their natal groups and placed in a separate enclosure or sent to another facility.

It has been known for years that gorillas, in the wild, congregate into all-male groups and live in relative harmony. These males may live alone or in such groups for life (Harcourt 1979). Within the past decade, zoos have started to experiment with all-male groups because of the excess of sexually mature male gorillas. Zoos have had recent moderate success with producing cohesive all-male groups. However, an all-male group is more likely to live peacefully together if: 1) at least some of the males are from the same natal group, 2) there are no female gorillas within the vicinity, and 3) the gorillas are brought together between the adolescent ages of six and ten (Stoinski, Lukas et al. 2004). It is surmised that gorillas within this adolescent age group, when placed together, build stronger affiliative bonds than if they were introduced after the age of ten (Stoinski, Lukas et al. 2004).

The sexual behaviors of gorillas have been infrequently observed and documented and are usually focused on female sexual behaviors. In heterosexual gorilla groupings, sexual encounters are typically initiated by females. The initiation of sexual activity has been linked to the female's reproductive cycle and greatly increases during the time of elevated fertility during a female's mid-cycle and visible tumescent condition (Nadler 1976; Fischer and Nadler 1978).

To date, there has been little data documenting male-male gorilla interactions in the wild (Stoinski, Lukas et al. 2004). Sexual behavior is often observed in captive, bachelor gorilla groups but copulatory behaviors between males are rarely mentioned in scientific publications. The specifics

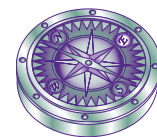
about the activities are seldom discussed in detail; genital touching and investigation by others, masturbation, oral-genital contact, and homosexual mounting occurs within these groups. In our political, moral, and socially capricious society, it may be difficult for zoo staff to explain these sexual displays to the general public. Even in female-only gorilla groups, homosexual behaviors between dyads of females have been observed (Fischer and Nadler 1978). Since few other published studies have focused specifically on captive or wild male-male sexual interaction, this study addresses the role that copulatory behavior may play within bachelor gorilla group social dynamics.

Methods

Subjects and Housing

There are three separate all-male groups of gorillas housed within the Downing Gorilla Forest exhibit at the Sedgwick County Zoo in Wichita, Kansas. The Losako troop and the Mbote troop are each made up of two silverback males, who range in age from thirteen to eighteen years. The focal group of this study, called the Melese troop, is made up of three seven-year-old adolescent males (Sampson, Jabir, and Virgil), and a small, thirteen-year-old black-back (Matt). All three seven-year-olds are from the same natal group at the Oklahoma City Zoo and are inter-related. Virgil was raised by the keepers at the Oklahoma City Zoo until fifteen months old because he was a twin with his sister Gracie. Matt, the oldest, was transferred to the Oklahoma City Zoo from Chicago at the age of two, and is unrelated to the other three. Matt has known the other three gorillas since they were born or introduced back into the family group at a young age.

There are two public display areas. Both are crescent-shaped areas with a wide bank of triple layered laminated safety glass which offers a panoramic view of the gorilla activities and allows the gorillas to be within inches of the public. The interior space is 2100 square feet with vertical climbing areas, high platforms, and hammocks for sleeping with fire hoses strung across for climbing. The outdoor space is almost an acre at 31,000 square feet. Not all the space is accessible to the gorillas because of buffer zones of foliage to prevent the gorillas from escape. The area has natural landscaping with plants that the gorillas can eat. The ground is soft and covered with fescue grass and patches of dirt. There is a large clear water pond that is approximately two feet deep. The gorillas occasionally play in the water, and the public is close by to watch from an outdoor balcony viewing area. There are two "tree houses" that have hammocks high



up and provide shady areas underneath. The back of the outdoor enclosure has a small hill that the gorillas frequently visit. The hill offers extra opportunity for play and semi-privacy. There is a third group area off public display that is equivalent to the indoor public display room. There are also eight individual sleeping enclosures out of public view. The gorillas rotate two days on public view and one day off. This study is limited to the public display areas only.

Data Collection

Data was collected over fifteen non-consecutive days using five minute scan sampling with special consideration for affiliative behaviors. An Ethogram of frequently observed behaviors was constructed and facilitated note taking (addendum A). This observational study was focused on sexual behavior patterns. Special attention was given to interaction between individuals when they were approximately two meters apart or closer. Behaviors of interest included mounting, presenting, genital examination, genital touching, masturbation, and displacement. Observations were taken in three hour blocks, with a short break in the middle of the observation period, and spanned the morning to early afternoon hours.

Results and Discussion

Displacements

Stoinski, Kuhar, et al. concluded in their study that linear dominance in an all-male group is statistically difficult to document because of the small group sizes involved. In only two of the nine groups observed in this 2004 study, was an individual recognized as clearly dominant over his group. By comparing the frequency of displacements, these researchers estimated the apparent dominance relationships within a dyad (Stoinski, Kuhar et al. 2004).

In the current study, displacement frequency was used as an indicator of dominance within the group and between dyads. Within this focal study group, Matt is the most dominant individual. Matt is at least six years older than the other three and is the largest gorilla in the group. These observations are an indication of his current rank within the group. It is unknown if his dominance will continue as the group matures.

The dominance of the three younger gorillas is more difficult to gauge. Jabir and Virgil had few displacements, and Sampson had no displacements during the observational period. Due to the number of times Sampson was displaced by the others, and his reserved nature, Sampson appears to be the least dominant within the group of four.

Table 1. Displacements

Displacer → Displaced	Total
Matt → Jabir	8
Matt → Virgil	3
Matt → Sampson	11
Jabir → Matt	2
Jabir → Virgil	0
Jabir → Sampson	3
Virgil → Matt	0
Virgil → Jabir	0
Virgil → Sampson	2
Sampson → Matt	0
Sampson → Jabir	0
Sampson → Virgil	0

Copulatory Behavior

Most instances of copulatory behavior were observed between Sampson and Jabir. These instances of mounting and thrusting were visually observed to be true copulation with full anal penetration. Not all episodes of mounting and thrusting were visually verified to have penetration, but it is assumed that most were successful copulations. All copulation events between Sampson and Jabir were observed with Sampson as the insertive partner and Jabir as the receptive partner. This dyad copulated, or mounted and thrust in the attempt to copulate, a total of twenty-seven times throughout the study. Most of the copulations were dorsal-ventral, with Jabir presenting, and Sampson mounting. The following observation is a typical session of sexual activity between Sampson and Jabir where there are many mountings in a relatively short block of time.

Observation 5a, 10:00 am, outdoor display: *Jabir approaches Sampson, bows, and places his head in Sampson's lap. Sampson touches his own genitals. Jabir turns to present for dorsal/ventral mounting; Sampson mounts and thrusts for approximately fifteen seconds then breaks away and sits down. Jabir sits up and is face-to-face with Sampson followed by a few seconds of open-mouth-play (similar to kissing). After less than a minute, Sampson mounts Jabir again for approximately thirty seconds of thrusting. At 10:02 am, Jabir and Sampson buddy-walk around the enclosure. At 10:06 am, Sampson and Jabir are back by the window. Sampson mounts Jabir, then breaks quickly. Jabir sits up, leans into Sampson, and receives a hug from Sampson. Sampson mounts Jabir, in a ventral/ventral position after Jabir touches Sampson's arm, bites it, and lies down in a supine*



position on the ground; penetration is not observed. Both get up and buddy-walk a few feet until Jabir stops and presents; Sampson mounts in dorsallventral episode for approximately fifteen seconds. At 10:09 am, Sampson tries to mount Jabir again; Jabir sits down without presenting. Sampson pushes Jabir. Jabir then presents and Sampson mounts for approximately fifteen seconds; Jabir breaks contact and moves away to sit alone. Sampson does not follow.

During one observation period (observation 7a, 9:32 am), Sampson and Jabir were in a ventral-ventral position with Sampson in the supine position lying on the ground. Jabir had mounted Sampson and was thrusting. It was first assumed that Jabir was the insertive partner and Sampson was the receiving partner. On further examination, it was discovered that Jabir was the receptive partner and controlling the copulation event by thrusting against Sampson who had an erection and lay motionless.

Virgil, the youngest of the four gorillas, was observed as the receptive partner a total of five times; four times with Sampson and once with Jabir. Virgil was seen mounting and attempting copulation with Sampson and Jabir, but was never successful during the observations. Both Sampson and Jabir broke contact when Virgil attempted to mount them. These attempts were not counted in the totals because the instances were very brief and mounting with thrusting was not observed. Matt was never observed copulating with or attempting copulation with Virgil or vice versa. Matt was observed as the insertive partner when copulating with Jabir twice. No other combination was observed during this study.

Table 2. Copulation Events

Insertive → Receptive	Total Copulation Events
Matt → Jabir	2
Matt → Virgil	0
Matt → Sampson	0
Jabir → Matt	0
Jabir → Virgil	1
Jabir → Sampson	0
Virgil → Matt	0
Virgil → Jabir	0
Virgil → Sampson	0
Sampson → Matt	0
Sampson → Jabir	27
Sampson → Virgil	4

Dyad Relationships and Personality Traits

Sampson and Jabir have a tendency to stay in close proximity to one another. This may be primarily due to the fact that they were born only a few days apart and may have learned to comfort each other from an early age. They both appear to be more reserved than Matt, and especially Virgil. Sampson is aloof and uninvolved in group activities some of the time. He is more inclined to sit back and watch group play before joining in. In the Sampson and Jabir dyad, higher group rank may belong to Jabir. Jabir has been observed displacing Sampson three times. During an observation (observation 7a at 9:40 am), Jabir was observed grabbing food from Sampson; Sampson did not act in retaliation. This did not appear to be a cooperative food-sharing incident. When food is placed into the enclosure, Sampson collects as much food as he can carry, and eats faster than any of the other three gorillas. He has been observed hoarding piles of vegetables and biscuits in secluded areas. Eating is a much more relaxed activity for Matt, Virgil and Jabir.

Virgil is six years younger than Matt and less than a year younger than Sampson and Jabir. As noted, Matt was not observed mounting Virgil. This dyad plays and sleeps together daily and exhibits nurturing behaviors towards each other. In the observations, it is apparent that Matt and Virgil have a strong affiliative relationship which includes food sharing. Virgil was observed pulling leaves off a branch that Matt was eating without reprisal (observation 12a, 9:04 am). Their relationship may be why Matt has never been observed copulating with or soliciting copulation with Virgil, although it cannot be stated that it has never happened nor never will happen in the future.

This may be due to multiple factors. In wild mountain gorillas, variation has been observed in the tolerance levels of dominant adult males toward younger males within family groups (Harcourt 1979). Wild adult male gorillas infrequently interact with infants because of the time spent foraging for food. Yet in captivity, adult male and infant interactions have been observed regularly. It has been hypothesized that silverback-and-infant play increases the social bond between the mother of the infant and the silverback, allowing the possibility for future breeding opportunities (Tilford and Nadler 1978). Since there are no females in this group, Matt has little motivation in that regard. Regardless of the motivations, bonding between adult and sub-adult gorillas is a normal and observed behavior.



Conclusion

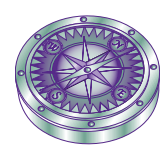
Studies involving gorilla sexual activity have focused mainly on heterosexual mating or female homosexual encounters with emphasis on the female hormone cycle as the motivating factor for these activities (Nadler, 1976; Fischer and Nadler, 1978). From the observations of homosexual and heterosexual activity of bonobo chimpanzees in the wild and in captivity, it is theorized that sexual activity is used as a greeting, appeasement, play, to relieve group tensions and anxieties, and to facilitate food sharing (Kuroda 1980; Parish 1994). In a more recent study, male bonobos were found to show submissive behaviors to large groups of females, leading to the hypothesis that bonobo society is matriarchal (Parish 1994). This study concluded that the motivations behind heterosexual and homosexual encounters related to the bonobo hierarchical structure, the role of sex in keeping peaceful relations within bonobo society, and the greater reproductive success of the species.

The routine occurrence of copulatory behaviors among the gorillas in this focal group leads to the conclusion that copulation is an important part of their socialization. Since sexual behavior in bachelor groups is not driven by females, the female reproductive cycle, or the need to reproduce, copulatory behavior within this group may be an important factor in the reduction of stress, for offering reassurance between individuals, and in the biological need for sexual release. The roles of insertive and receptive partners may not be exclusively based on dominance, but rather on the reassurance of one or both partners. At this time, it cannot be said that presenting is necessarily a position of submission, but rather, may be a simple invitation and consent to the sexual act. The roles of insertive and receiving partners may have simply been chosen by individual preference. In the dyad between Sampson and Jabir, Jabir may be the more dominant of the two, yet Jabir is always in the role of the receiving partner. Acting as the receiving partner may allow him a higher rank within the group of four.

More research on wild and captive bachelor gorilla groups is needed to add to the body of knowledge necessary to understand these beautiful and complex animals. Further investigations should be conducted with special attention given to the age of the individuals, group hierarchy, and the familial relationships of the male gorillas in the observed groups.

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Appendices

Addendum A - *Ethogram: Behavior categories and definitions

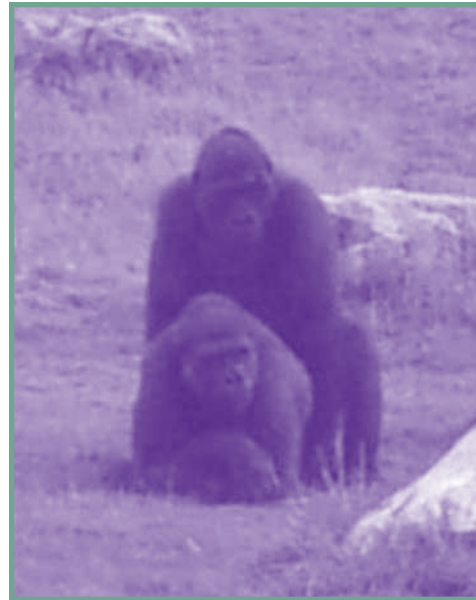
Behavior	Definition
Masturbation	Rhythmic rubbing of genitalia with any part of own body or object
Genital touching/examination	One individual touching of genitalia or examining the genitalia of another individual
Sexual Mounting	Mounting and thrusting, dorsal/ventral or dorsal/dorsal (may be unknown if penetration has occurred)
Presenting	Presenting rear for mounting or genital investigation by partner
Affiliative	sitting close to another gorilla (≤ 2 meters)
Social grooming/Examination	Social grooming or touching of any body part except genitalia
Social Play - running/chasing	One individual chasing another in play; brief touching and/or grabbing or no touching
buddy walk	two walking together with arms around each other or holding hands/arms
Social Play - wrestling	grabbing, biting, holding in play; may turn aggressive
Display	Throwing objects, swinging or running to hit glass, beating on chest or abdomen
Aggression	Any contact or display that leads to displacement
Displacement	An individual's departure of an area upon the approach of another individual (avoidance; dominance).
Solitary sleeping/lounging	Sleeping or laying alone (≥ 2 meters from other gorillas)
Social sleeping/lounging	Two or more individuals sleeping or laying near each other with little interaction; can have some contact (non-sexual)
Out of view	Animal is not visible to researcher
Interaction/display toward people	any interaction with public such as banging window (display), sitting and watching, etc.
Solitary activity	Playing, eating, sitting alone and ≥ 2 meters from other gorillas

*Ethogram was compiled by behaviors observed by Jan Mead-Moehring and inspired by and modified from a series of gorilla ethograms compiled by the Gorilla Advisory Group at Primate Info Net <http://pin.primate.wisc.edu/aboutp/behavior/gorillas2.html>

Pictures

1. Dorsal-ventral mount

Sampson insertive → *Jabir receptive*



2. Ventral-ventral mount

Sampson insertive (top) → *Jabir receptive (supine)*





Comparative Analysis of Critical Thinking Skills among Students at Wichita State University

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T

Summary

There has been a great deal of research establishing that critical thinking skills are derived from the liberal arts education that each American receives in public school. Additionally, the critical thinking skills required by the job market are further refined through the liberal arts education that many receive at a college or university. However, there is currently a dispute whether each student in each individual major at a university is learning the same caliber of critical thinking skills.

Three separate studies determined that Liberal Arts and Sciences majors had a positive impact on critical thinking skills. A study performed by Eigenberger et al. set out to determine which college major has the best critical thinking skills (Eigenberger, Sealander, Jacobs, & Shellady, 2001). The results were that Liberal Arts and Social Science majors showed the highest levels of critical thinking skills. Another study by Pascarella et al. attempted to determine a correlation between education and decision making skills (Pascarella, Wolniak, Cruse, and Blaich, 2004). This study determined that the more time students spent at a Liberal Arts college or university, the better their decision-making skills. A third study by Ciancarlo and Facione (2001) combined ideas from the first two studies and examined the correlation between time at a Liberal Arts university and critical thinking skills versus a research based university and critical thinking skills. Results of this study also indicated that Liberal Arts and Sciences college majors had the highest level of critical thinkers.

While this research demonstrates the importance of a liberal arts education in gaining critical thinking skills, it is now being questioned whether students are learning the caliber of critical thinking skills necessary to consider the influx of information and technology over the past several years. An editorial



by Baker (2000), summarized a conference of business and education leaders held in 2000, which discussed the importance of the Liberal Arts education. It was the opinion of this conference that students currently enrolled in colleges and universities are not receiving the critical thinking skills needed to perform the jobs they are being trained for. A conference of business leaders, held in 2003, further supported this argument by stating that the universities and colleges are not teaching the critical thinking skills necessary to work in the business field (Flynn, 2003). Businesses must hire students with business degrees because of the expense of training; at the same time these applicants do not have the desired critical thinking skills because they are not taking the Liberal Arts courses that refine those skills.

The purpose of this study is to determine if students in all majors at Wichita State University are learning the same level of critical thinking skills. Based on the literature, we hypothesized that students majoring in the Liberal Arts and Sciences College would have the highest level of critical thinking. A survey measuring decision-making skills was given to 156 participants from the colleges of Business ($M = 131.19$, $SD = 17.16$), Education ($M = 132.68$, $SD = 16.97$), Engineering ($M = 137.34$, $SD = 17.90$), Fine Arts ($M = 125.0$, $SD = 13.62$), Health Professions ($M = 142.38$, $SD = 15.11$), and Liberal Arts ($M = 136.86$, $SD = 17.14$). A critical

thinking scale was comprised to create a critical thinking score, and descriptive statistics as well as a one-way ANOVA were run to determine if there were any significant differences between the critical thinking scores of the six colleges.

Results showed that there was indeed a significant difference in the data sets. Upon further investigation, a Bonferroni post hoc revealed that there was only one significant difference in all of the data sets. There was no difference found between any of the colleges and the college of Liberal Arts and Sciences. The only significance found was between students in the college of Health Professions, which had significantly higher critical thinking scores than students in the college of Fine Arts. These unexpected results may be due to many variables affecting critical thinking skills. Those variables may include age of participants, changes in major, or the existence of a double major.

In the future, we would like to perform a longitudinal study testing subjects as they come in as freshman and leave as graduates. With the extra data, it would be possible to remove some of the confounding variables allowing us to determine if students in each major actually have different levels of critical thinking skills. With that information, Wichita State, and possibly other universities, could change curriculum as necessary to provide higher levels of critical thinking preparation to all students regardless of major.



The Relationship Among Reason-giving, Experiential Avoidance, and Levels of Depression

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Summary

In most cases, depression is seen as a mood disorder; treatment is centered on changing unwanted feelings and associated behaviors including the ways of thinking being described by the client (Zettle & Hayes, 2002). However, in the new process of Acceptance and Commitment Therapy (ACT), treatment focuses on the contexts surrounding these depressive behaviors rather than altering the prevailing mood itself (Zettle & Hayes, 2002).

With ACT becoming more widely practiced, it is beginning to examine more specific psychological issues such as depression. The ACT perspective of depression looks at the pathological links between emotion, cognition, and behavior and investigates the contexts that support such relationships. ACT sees experiential avoidance as one of the contributing factors in the initiation, maintenance, and exacerbation of depression. This occurs when a person is unwilling to experience certain private experiences (bodily sensations, emotions, thoughts, memories, or feelings) and takes steps to alter or avoid the experience or the contexts in which they may occur (Hayes et al., 2004).

Research investigating experiential avoidance utilizes the Acceptance and Action Questionnaire (AAQ), a self-report instrument that looks at various aspects of experiential avoidance, which include the ability to take action in the context of inhibitory thoughts; the presence of worries, anxieties, or negative evaluations associated with private events, and the tendency to attempt to eliminate and control private events (Hayes et al., 2004). The AAQ has been found to correlate significantly (moderate to high) with measures of general psychopathology as well as with more specific instances, including depression. For example, the AAQ correlated moderate to high ($r = .36$ to $.72$) with the Beck Depression Inventory (BDI) (Hayes et al., 2004; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).



Rumination and reason-giving are forms of experiential avoidance that are particularly relevant in depression. Reason-giving serves several purposes. For example, reason-giving can be used to excuse behaviors, resist inducements to change, or both. Another purpose of reason-giving, and the one we are more interested in, is to serve as an attempt, publicly or privately, to solve a problem such as depression by discovering its causes (Addis & Carpenter, 1999). Addis et al. (1995) developed a self-report measure to empirically investigate the reasons given by both clinical clients and “normal” subjects for the depressions they may currently be suffering. The Reasons for Depression Questionnaire (RFD) was constructed to measure the explanations people give for being depressed. The scores on the RFD were found to be associated with levels of depression, responses to treatment rationales, the therapeutic processes, and therapeutic outcomes.

The purpose of this study is to investigate the interrelationships between reason-giving, experiential avoidance, and depression in order to further uncover the particular role that reason-giving may play in the documented relationship between experiential avoidance and depression. A sample of at least 100 undergraduate students were administered a general survey comprised of the BDI, AAQ, and the RFD. It was hypothesized that both the RFD and the AAQ would positively correlate with the BDI, and the RFD total, and subscale scores would be correlated with the AAQ such that the RFD may account for the relationship between the AAQ and BDI.

Results indicated a significant relationship between the AAQ and RFD total with the BDI. These results support the first hypothesis that the AAQ and RFD total would be positively correlated with the BDI. To further understand this relationship, a partial correlation between the AAQ and BDI while controlling for the RFD total was run to see if

the relationship between the AAQ and BDI is accounted for by the RFD. However, results indicated that the RFD does not account for the relationship. A significantly positive correlation was still found between the AAQ and BDI ($r(114) = .554, p < .000$). A series of hierarchical multiple regression analyses were conducted to determine the degree to which RFD and AAQ scores independently predicted variability in the BDI. Participants scoring higher on both measures tended to have higher levels of depression. Results showed that both the RFD total and AAQ account for the variability in the BDI.

Hypothesis Two predicted that the RFD total and subscales would correlate significantly with the AAQ. This prediction was supported in that the RFD total and the AAQ were significantly correlated ($r(114) = .341, p < .01$). Additional results indicate that six out of the nine subscales positively correlated with the AAQ.

The main objective of this study was to determine and examine the relationships between the AAQ, RFD, and the BDI as to further indicate the role that reason-giving plays in experiential avoidance and in depression. The results reported indicate that reason-giving does play a pivotal role in levels of depression as well as in the levels and maintenance of experiential avoidance. These results give further evidence to the AAQ as related to the BDI, provide a new look at the relationship between levels of experiential avoidance, levels of depression, and reason-giving. The findings from this research also show that the RFD and AAQ, even though correlated together and to the BDI, have unique variance in the BDI. These results have implications that show that the RFD has unique contributions to the BDI which can be included in ACT therapy to help diffuse the reasons that people offer for their depressions.



Ammonia Oxidation and the Detection of *amoA* (Ammonia Monooxygenase) in Hypersaline Soils

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Summary

The Salt Plains National Wildlife Refuge (SPNWR), located in northern Oklahoma, is an extreme, non-aquatic environment which has been formed, in part, by a continuous up-flow of sub-surface, saline ground water. Salt crystals and brine pools form atop the salt flats after long periods of little or no rainfall. A period of heavy rain, however, dissolves the salt crystals and rapidly changes the salinity of the environment. These changes in salinity are accompanied by changes in temperature, pH, nutrient availability, and the disturbance of community structure in the soil. The microorganisms that inhabit this area are required to be versatile and adaptable to such a rapidly changing environment. Recent studies show certain biogeochemical cycles are known to exist in the saline soils at SPNWR and in many other extreme environments[1-4]. The current project seeks to determine the presence or absence of *amoA* (Ammonia Monooxygenase) genes in the saline soils.

The presence of the gene will initially be determined through end-point polymerase chain reaction (PCR) with *amoA* specific primers and gel electrophoresis. PCR is a process in which a targeted length of DNA (the targeted fragment length in this study is approximately 491bp, Horz et al. 2000) is amplified exponentially through a series of steps using specific primers, a buffered solution, and a heat stable polymerase enzyme, usually taq DNA polymerase originally extracted from *Thermus aquaticus*.

PCR requires three steps: melting, annealing, and extension. The melting cycle is used to separate the double stranded DNA so that site specific primers can bind to the target area; the temperature is usually 95 degrees centigrade. The annealing step occurs at a lower temperature, which is dependent on the primers used. This allows for the primer to bind to the target site. In



the extension step, the polymerase is used to extend the target DNA fragment; the temperature is set at 72 degrees centigrade. Gel electrophoresis is then run with a two percent agarose gel to allow for the different sized fragments to separate. Once the determination is made through end-point PCR that the gene is present, counting the gene with real-time PCR allows the researchers to calculate the gene abundance in the soil. In real time PCR, a fluorescent dye is added to the reaction mixture. This dye fluoresces when excited by ultra violet light, which allows for more sensitive PCR detection. The fluorescence detection can be quantitative by relating a known DNA concentration to the number of cycles before detection; from this, one can build a relation between cycles until detection and DNA concentration. Knowing the DNA concentration of a sample allows calculation of the gene copy number.

To facilitate the search for the gene, soil samples were extracted from different sites at SPNWR—the two main sites being Henley South and Henley Central—using a modified method developed by Burgman et al. The positive control was extracted from pure culture *Nitrosomonas europaea*, which underwent four sequential freeze thaw cycles of one mL volume and was stored at -20 degrees centigrade. The PCR cycles were subsequently run with a volume of 50uL with *amoA* specific primers and with an initial melting cycle of 90s at 94.0 degrees centigrade. The PCR process continued at 94.0 C melting for thirty seconds, 55.0 C annealing for one minute, and 72.0 C extension for one minute. These cycles were repeated thirty times. The final cycle was run at a 72.0 C extension for two minutes.

The samples were then taken and run in a two percent agarose gel for ninety minutes at 90V. The gel was stained in ethidium bromide, and a picture was taken under 1.5 second UV exposure. Real-time PCR was run using takara premix with the same *amoA* specific primers. The standard curve was built from the PCR amplified product of the positive control; ten fold dilutions were made of the product until the concentrations reached femto (10^{-15}) grams of product per uL of sample. The number of genes was calculated using the concentration of the sample of PCR product.

The amplification with *amoA* specific primers has given a positive presumptive determination of the genes in the saline soils of SPNWR. Samples from Henley Central yield weak bands after being run with PCR; samples from Henley South have yet to yield banding from PCR amplification. Relating a known DNA concentration to the number of cycles to detection yielded a standard curve and yielded an equation: $y = -3.297\log(x) + 31.838$. Solving for x will yield a DNA concentration of a sample run with real-time PCR allowing the gene copy number to be calculated. Further study of the area is necessary to get more accurate DNA concentrations.

Consistent amplification of the *amoA* gene in SPNWR soils along with preliminary gene counts is a presumptive identification of the presence of the organism in this area. To further identify the organisms present, cloning and sequencing of the sequence will be necessary. Before conducting further molecular studies, it would be fair to make an assumption that a complete nitrogen cycle is currently present at the Salt Plains National Wildlife Refuge.

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A Comparison of Cognitive and Sensory Abilities in Young and Older General Aviation Pilots

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T

Summary

he population of older adults is increasing significantly. Hence, the percentage of older general aviation pilots (GA) is increasing as well. There is a stigma attached to the abilities of older pilots, who are thought to be at a higher risk for various flight problems, including accidents. At the age of sixty, commercial pilots must retire, and general aviation pilots are subjected to higher insurance premiums. Although general aviation pilots are allowed to continue flying, they are required to pass annual medical evaluations in order to retain their licensure. Because of these standards, it is possible that older GA pilots will differ little in ability compared to their younger counterparts. Furthermore, older GA pilots have more experience than younger pilots and therefore may be able to compensate for age related declines.

As individuals age, they experience cognitive and sensory declines which could increase their risks for problems and accidents. Physical changes that occur in the eye can affect vision as a person ages (Colavita, 1978). Beginning roughly at age 40, individuals experience a reduced ability to focus on near objects. Consequently, the ability to clearly see letters or numbers or to read text is impaired. Similarly, older adults experience declines in distance visual acuity, the ability to see low contrast stimuli (Sloan, 1988), and show increased sensitivity to glare. While some of these changes can be corrected by wearing glasses, others cannot and may represent obstacles for an older pilot. However, older pilots could experience difficulty reading gauges, maps, or seeing instruments. Likewise, they may have difficulty seeing fine details or low contrast objects outside of the aircraft.

Auditory sensitivity is another age-related change that may affect an older pilot's performance. These changes include not only changes in sensitivity to pure tones, especially higher sound frequencies (e.g. >3000Hz), but also



a decreased ability to understand spoken language in the presence of noise. Findings related to speech intelligibility are potentially significant given the importance of communication between pilots and air traffic control and the presence of significant levels of ambient noise found in aircraft cockpits. In a study conducted by Morrow et al. (2003), pilots listened to air traffic control messages and were asked to repeat them back. Morrow found that younger pilots more accurately recited the messages back than older pilots did. "There was, however, some evidence that more flying experience among older pilots (compared to younger pilots) may help buffer against age-related declines in cognitive resources, in order to maintain performance on the read back task" (Morrow et al., 2003). It is also possible that older pilots may be able to compensate for declines in auditory sensitivity by relying on contextual cues and greater experience.

Cognitive abilities, such as multi-tasking and memory, are integral parts of flying. Pilots have to maintain correct speed, position in the air, altitude, and a variety of other variables equally crucial to flight safety. Several studies have focused on multi-tasking, or "task switching," which is alternating specific tasks during a series of trials (Tsang, 2003). In these studies, the time it took a participant to respond to the command to switch tasks was measured. The study used younger and older pilots and found that practice affects benefited both groups. This supports the idea that practice or experience may improve some of the sensory declines experienced by older pilots. In certain situations, this could ultimately put an older pilot at an advantage.

In the regular proficiency checks and scheduled medical evaluations as part of the license renewal process, individuals with relevant medical conditions or demonstrating declining cognitive and sensory abilities are not eligible for renewal. Because of these stringent requirements, older licensed pilots may differ little from their younger counterparts. To test

this hypothesis, pilots were recruited from aviation groups around Wichita, Kansas. Two groups of pilots participated: younger pilots age twenty-four to fifty-nine and older pilots from age sixty to eighty-eight. Participants were tested on measures of memory, far and near visual acuity, tactile sensitivity, intelligibility of spoken language in noise, and auditory thresholds.

Significant differences in performance were found in four of the assessments that were used: the logical memory assessment, far visual acuity, auditory thresholds, and tactile sensitivity. All four of the assessments showed that younger pilots yielded better scores than did the older pilots.

More research is needed to document the nature of age related changes across different cognitive and sensory domains and to understand how these changes affect flight skills and safety. Furthermore, research is needed to correlate whether experience or expertise plays a role in the decline of older pilots in comparison to their younger counterparts.

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