Psychology Research Methods Journal

Volume 1 | Issue 19 Article 12

6-2016

Effects of Music on Puzzle and Math Problem Solving

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The purpose of this project is to see how different music genres affect performance on word searches and multiplication problems. The present study consists of four 10 min rounds; each round including a genre of instrumental music: classical, heavy metal, or pop, and silence. Students did four different word searches and four different 100-problem multiplication worksheets; one word search and one multiplication worksheet per round. Lastly, a survey about their daily music use and opinions of the experiment's music, will take 5-10 min. The results of this study were analyzed using a one-way ANOVA to compare the students' performances on the two tasks completed under each genre of music. I hypothesized silence will produce better results than music, but with music, classical will be better than heavy metal or pop. Silence would provide sole concentration on the task, while classical is known to be relaxing and is a sign of intelligence if listening or having some other involvement with it. The first hypothesis was shown to be true, while the second was false, since metal music was the best or second best condition for each task.

Studies on how music has been influential on studying as well as memory have been highly conducted among researchers. The hypotheses for this experiment focuses on the background conditions, as silence is predicted to be the condition in which students do the best on both tasks, while between just the genres of instrumental music, classical will show the most favorable results compared to pop and metal music. The focus on how the task is affected by mere presence of background music is more uncommon than other manipulations of independent variables. In recent studies, the manipulation of music not only includes different genres, but also the speed, loudness, and the mood of the music as well. There is also more of a focus on different

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groups of students; personality traits and musical training are examples most commonly used in background music studies for comparison.

Some researchers look for specific participants to further their results, and one common category participants were put in for background music studies was whether they were musicians and/or non-musicians. Three studies used this categorization, and had a different use of background music; whether it be the speed, the loudness, or the genre (Kang & Williamson, 2013; Thompson, Schellenberg, & Letnic, 2011; Yang, Mcclelland, & Furnham, 2015). Thompson et. al. (2011) were looking to see the difference between musicians and non-musicians in the loudness and speed of the music. They defined participants as having musical experience if they had at least two years' worth of lessons, while non-musicians had usually zero to one year's worth of experience (Thompson et. al., 2011). The test administered to all participants was a reading test that involved reading a passage and answering question about what was read. The results showed musically-trained participants did better in each variation of music speed and loudness over those with no musical training.

The hypothesis of musicians doing better than non-musicians was also kept alive in a study where musicians were categorized by whether they were piano players or guitar players (Yang et. al., 2015). One participant took three different tests while listening to one of three different instrumental music pieces, which included a guitar, piano, and saxophone solo; all within the genre of jazz. The tests involved math, grammar, and an algebra and geometry test

used to usually determine IQ (Yang et. al., 2015). There was no effect on the math test when it came to musical experience, but guitar players did worse on the grammar test while listening to guitar music, while piano players did worse on the algebra-geometry based test when listening to piano music. In the researchers' discussion, they postulated that the results could have been influenced in part by the fact that musicians who are familiar with a certain instrument may be concentrating more on the familiar music than the task, and thus perform worse than non-musicians.

Another study had researchers believe the hypothesis of the previous study; that musically-inclined participants will do better than those who are not, the only difference is they were tested to see if they could learn some common words and phrases of another language better under music or no music (Kang & Williamson, 2013). There were two languages involved, and people were assigned to groups for each language. Within each group, they were further divided in half to learn the language with or without music (Kang & Williamson, 2013). The participants were given two weeks to learn the language they had chosen, which was either Arabic or Chinese. Five CD tracks were listened to daily in certain patterns and the additional task of writing down what was done that day in a diary was provided by the researchers, before coming back to report the results in various tests on the computer after the 2 weeks were up (Kang & Williamson, 2013). It was found that those who were musicians or non-musicians did not show any significance in language learning under no music or music which the researchers

suspected was because it was short-term learning. This shows that the difference between musicians and non-musicians can vary, and it might be because of the genre, speed, or loudness of the music, or the feeling the music gives the participant (Dobbs et. al., 2011; Kang & Williamson, 2013; Thompson et. al., 2011; Tze & Chou, 2010; Yang et. al., 2015).

A common way to control for differences in music is simply to pick different genres or styles. A study conducted in a "medium-sized college" in Taiwan used western music such as "light" classical and hip hop to see how English majors performed on reading tests (Tze & Chou, 2010). There were three different groups; one for each genre and another in silence, and each group completed the same three different reading prompts and questions. Silence turned out to produce the most correct answers to the reading prompts while hip hop showed the worst scores (Tze & Chou, 2010). However, silence and classical music were shown to be similar in results, even though silence was the best.

Another study used the genre of "garage" music, which is common in the United Kingdom and includes electronic-dance music and more unknown artists (Dobbs et. al., 2011). The experiment also consisted of noise (classroom and playground noises) and silence as independent variables, and each group of female school children ages 11 to 18 was placed in one of these three conditions, yet completed each task in each condition. The three tests included finding a missing piece within a picture, a math test with comparisons, mistakes, geometry, and story problems, and a vocabulary, sentence, and grammar test (Dobbs et. al., 2011). The scores

on each test corresponded with each genre and whether the participant was introverted or extraverted; which was measured before the three tests were taken. Extraversion scores showed slightly better performance with noise on the first test (picture), music on the math test, and on the grammar test with noise (Dobbs et. al., 2011).

Another study did not use multiple genres, but one genre of jazz using three different instruments: a piano, a guitar, and a saxophone (Yang et. al., 2015). Participants were tested in a math test, a sentence-checking test, and an algebra-geometry test to see whether they performed better under one of these music conditions. There were also the variables on whether they were pianists, guitarists, or non-musicians (Yang et. al., 2015). The results showed no difference in math performance under each genre, but piano players did worse on the algebra-geometry test under piano music while the guitar players did worse under guitar music for the sentence-checking test. Non-musicians did best on both piano and guitar music for the sentence-checking and algebra-geometry test, showing that familiar music and knowing the structure of it can be a distraction (Yang et. al., 2015).

Music can also be manipulated by the experimenter by speed, arousal, and whether it is outside music or music made up by the experimenters. In a study conducted in a Swiss university, tempo or speed and “in-tune” and “out-of-tune” music was controlled by the experimenters, as well as a background sound of noise, which included “brown” noise (Jäncke & Sandmann, 2010). There were five different background conditions: four that combined fast and

slow tempos, and in-tune and out of tune music, for example: high tempo in-tune music, and just the noise condition. The test was to see if participants could recall made-up words while listening to one of these background sounds (Jäncke & Sandmann, 2010). The number of milliseconds was counted after the participant was presented a word, and it was found that the best condition for recall was in-tune slow music, while in-tune fast and out-of-tune slow were the worst. Emotional satisfaction and arousal ratings were also measured using surveys after the test, and it was found participants were happier with the in-tune music and arousal ratings were not significant.

However in another experiment, arousal did play a difference in the results. A study also conducted in Europe tested to see if unknown music made by the experimenters or music that participants brought with them, was better during a driving simulation task (Cassidy & Macdonald, 2009). The experimenters also controlled for arousal in their music selections, as the levels were high and low arousal, but the music participants brought was songs that have been popular on the UK charts in the past 5 years. The accuracy of their driving was measured; which was how many mistakes they made, their time per lap, and their lap speed average (Cassidy & Macdonald, 2009). It was found that high-arousal music offered the most inaccuracies, and longest lap times, while self-selected music had the lowest inaccuracies, best lap times, and highest average speed. Arousal and mood was also measured before and after the experiment, and high arousal was associated with high distraction, low enjoyment, low liking, low

appropriateness, high arousal, and low liking compared to self-selected music and sometimes the low-arousal music (Cassidy & Macdonald, 2009). Music can hinder or help a person based on what he or she knows and what task they are doing, and there are many tests used to see whether background music affects their results.

Testing can be done in many ways for background music, as school subjects like language, reading, and math involve different processes and possibly take more concentration than another. Background music can be more of a hindrance or an aid to doing well on a task, and can be shown in the similar topics of reading and language. Two studies involved reading while listening to certain types of music, which were Thompson et. al. (2011) and Tze and Chou's (2010) studies. For Thompson et. al. (2011), they used four reading passages from the GMAT, which is a test used for students to be eligible for graduate school. They had participants listen to slow and soft, slow and loud, fast and soft, and fast and loud music for each passage. It was found that fast and soft increased the correct answers for the passage, while fast and loud showed the worst performance (Thompson et. al., 2011).

Subsequently in Taiwan, the students were English majors and they took three different English-language reading tests, each being a topic native Taiwanese students understood, so they did not get distracted from not knowing English or Western topics as well (Tze & Chou, 2010). However, each group did all the tests and the differences between them were not tested. Grammar tests, in which students fixed errors in sentences, were also used in two studies. Results

of these tests showed pianists did slightly better than non-musicians while guitarists did the worst (Yang et. al., 2015), while in another study, extraverts did the best under noise, then silence, and lastly music (Dobbs et. al., 2011). A related test to language skills was also included in a study where learning made-up words was influenced by different background music and noise. Before the actual experiment began, subjects were given a pretest to see how good their verbal memory was with their own language (German), as to rid of any subjects who already had trouble with words they knew (Jäncke & Sandmann, 2010). They were shown one word at a time on a computer screen, and were told to press the "right" button if it was a new word in the list, and the "left" button if an old word showed up. The same test was done during the initial experiment, only with made-up and meaningless words under different background conditions (Jäncke & Sandmann, 2010).

Math was also a common dependent variable, as basic tests and the Wonderlic Personnel Test were used to measure outcomes of background music. The Wonderlic Personnel Test was also used in the extravert and introvert study, as well as the pianist, guitarist, and non-musician study (Dobbs et. al., 2011, Yang et. al., 2015). This test showed that non-musicians performed the best and that music and silence would produce the best results, yet in the musician study, music was used constantly but did not affect the non-musicians. Since it was math and algebra-based, the explanation might be that liking music for non-musicians and subjects not tested for those qualities do well (as well as extraverts), while those who are taught music are more easily

distracted, as well as introverted (Dobbs et. al., 2011, Yang et. al., 2015). A more basic math test in the musician study was also used and only involved answering up to 30 addition problems within a 4-min timeframe, and guitarists did better than piano players and non-musicians, yet it was not a significant difference (Dobbs et. al., 2011). It seems like language tasks can be helped with more calm music while math tasks depended on how easily distracted one was when listening to the music, as more quiet or soft music helped introverted over extraverted people who need more sound in the background.

The study I conducted had instrumental music as the independent variable, and three different levels which included classical, metal, and pop music. A control condition was also included, and this was silence. Each participant did two tasks under each level of the independent variable and in silence, and the tasks included finding as many words as possible in a 20-word word search, and solving as many double-digit multiplication problems possible out of 100. students completed the word search and then did the multiplication problems, each task lasting 5 min for a total of 10 min, and both tasks were done during each background condition. Each word search was different theme, and the multiplication problems were all in a different order for each round. Students then took a survey after participating in each condition, and this was to see how they used music in their daily lives as well as feedback about the music used in the study.

Method

Participants

A total of 35 Lindenwood University students between the ages of 18 and 24 years old participated in the experiment through the Lindenwood Participant Pool (LPP) program or by contacting the researcher through fliers (see Appendix A) posted in Young Hall, which is a building designated to the School of Sciences on campus. The fliers contained the researcher's email and phone number for contact, as well as tearable tabs for those interested to take with them. All Lindenwood students could participate, but all the students came from the LPP. LPP students received two credits that could go to a class participating in the program, and the bonus point value of each credit depended on the instructor (i.e. one credit is two bonus points). If there were students recruited through the flyer, they would receive no compensation for their participation. Sona Systems was the recruitment site used for LPP students and for the researchers to keep track of when and who took their studies. Participants had the option of choosing whatever date and time was convenient for them to participate by signing up for a timeslot the researcher posted; a maximum of 12 students could enroll for that certain timeslot.

Materials and Procedure

A room booking request was first emailed to the LPP office to obtain a room or rooms. The room was a classroom size of 20-30 desks, and had a computer for the researcher to be able to give credit through Sona Systems and access files needed for the experiment. A group of 1-7 students per time slot came to the room they signed up for through Sona Systems. All students

signed in on a participant list to account for their presence during the experiment and to validate their extra credit. Students were also given a participant receipt for participating through the LPP. Students then chose a seat wherever they felt most comfortable. Before the experiment began, each student received two informed consent forms (see Appendix B) from the researcher to confirm their willingness to participate in the experiment. One form was kept by the student and the other was given to the researcher. The students then took out their writing utensils to start the experiment.

There were four different word search puzzles (see Appendix C-F), each with a different theme with instructions posted on the bottom of each word search. The themes were animals, ice cream flavors, college life, and summer, and the instructions explained that the words could be found vertical, horizontal, and diagonal. There were also four different packets of multiplication problems (two digit by two digit), each labeled either A, B, C, or D, and consisted of one-hundred different problems (see Appendix G-J). Each student did one word search for 5 min, and then a multiplication packet also for 5 min, for a total of 10 min. To prevent possible cheating on either of the puzzles, a classroom with many seats was secured to allow for space between students and different orders of the word searches and multiplication problems were randomized. students were instructed to find as many words out of 20 possible in the word search, and to complete as many of the multiplication problems by hand.

There were four rounds total for each timeslot, and each round consisted of a different instrumental background music: metal, classical, or pop, and silence as the control. Each student had a packet in order of word search and multiplication problems, so papers did not have to be passed out for each round. The results would measure how many words were found during each condition in the word search, and how many and how correctly multiplication problems were solved during each condition. After all four rounds, students took a paper survey (see Appendix K) that asked them questions about how they use music in their daily lives and their opinions on the music used in the experiment. The survey usually took between 5-10 min to fill out, but there were few instances where it exceeded that time for certain students. At the end, students turned in their packet of word searches, multiplication problems, and the survey to the researcher. They were thanked for participation verbally and by a thank you letter (see Appendix L). Students were free to leave and LPP students were reminded to turn in their participant receipts.

Results

Separate one-way ANOVAs were conducted to see if music condition affects the performance on the word search and the multiplication task. The first hypothesis was that silence would show better performance on both tasks compared to the genres, but classical music would show to be better out of the three music genres. The first hypothesis was shown to be correct, as for the word search ($F(3,136) = .30$, $p > .05$; $n^2 = .007$), the highest average was 12.94 but it was not significantly different from the other genres. With the multiplication problems, metal music

and silence (M = 15.4) were better when doing a large amount of problems in general (F (3,136) = .117, p > .05, n^2 = .003). However, multiplication problems solved correctly (F (3,136) = .194, P > .05, n^2 = .004) displayed the best results during just silence (M = 12.51, SD = 5.83), which shows accuracy can increase with no music playing. The least amount of words was found during classical (M = 12.17, SD = 3.96) and pop music (M = 12.17, SD = 4.42), and the least multiplication problems done (M = 14.77, SD = 5.08) and correctly done (M = 11.54, SD = 5.46) were during classical music. Classical was never shown to be the best genre in either task compared to the other genres, but metal was either tied with or the best genre compared to silence in all conditions.

In terms of the results for words found during the word search, the average was around 12 out of 20 for each condition. Multiplication problems were assessed by how many were completed and how many were completed accurately. The average number of problems completed during the 5 min mark was 15, with the lowest being 14 problems. The accuracy of multiplication problems was assessed by if the person got the correct answer, and the average was lower compared to the amount attempted. The average was 12 problems correct, and the least amount correct was 11.

The survey was conducted to see what genres the students listened to often, how often they used music for certain activities, and whether they recognized and liked the music they heard during the study. Genres that students themselves liked included a wide variety: pop, rock

(17%), country (17%), electronic (11%), and hip hop (8%), and the most popular among students was pop, with 43% saying they listen to this genre the most often. The most common places students listen to music is in the car (63%) and somewhere at home (55%), particularly in the bedroom (49%). Since music can come from many sources, devices and apps are used commonly to listen to music and the most popular were using a phone (91%), radio (51%), laptop (37%), YouTube (31%), iTunes (20%), Spotify (23%), and CDs (29%). Music was basically a daily part of life, and used in many activities such as studying (63%), exercising (74%), cooking (46%), walking (9%), and cleaning (9%). The music that was most liked during the study was pop (60%), with classical being a close second with 51%. Some songs were recognized, which were mostly the pop songs (83%) and some classical songs (71%). The artist and titles of the songs were recognized as well, especially with the pop music.

Discussion

The first hypothesis for this study was supported, as silence was the best condition, while the second hypothesis was unsupported, as metal music was the best out of all the genres. While other studies measured the type of students who took the test, such as musicians and non-musicians, or introverts and extraverts (Dobbs et. al. 2011; Yang et. al. 2015), this study focused more on the music genres and tasks. The only task that was remotely like a test compared to previous studies, was that participants took a type of math test (Dobbs et. al. 2011; Yang et. al. 2015), but it was in more complicated forms in previous studies than the double-digit

multiplication offered during this study. However even during this study, some students got all or most questions wrong, and one student also opted out half-way through the study because she had forgotten the process of solving one of these problems by hand. The reasoning for doing more poorly on this part of the study could be not remembering how to multiply by hand, since most people just use technology for most math, even simple math learned during elementary and middle school years.

The 5 min time limit might have also added pressure, and this includes the finding of the words in the word search. Yet for some of the word searches, finding more than 15 words out of 20 or even all 20 was common, especially during the "summer" themed word search. The themes were made to be more positive, familiar, or neutral so the effects of the music could be more accounted for the results rather than the feelings provoked by the words found, but since the summer word search would initiate more positive feelings, this might have motivated more words found. The survey results also might have been more accurate if every question was answered, as some students skipped the activities portion totally and gave short answers for the first six questions of the survey. Answers might have possibly been falsified, and doing a study right before a class might have meant short or rushed answers.

With genre having no effect on the word search or multiplication problems solved or correctly solved, this might be due to the sample size or the time limit of the study. There were 35 total students, so possibly a bigger sample size might produce more discrepancy in results or

even more favorable results towards the hypotheses. The age group tested included just college age students, so it would be interesting to see results with a younger or older age group to see if music affects their ability to find the words or solve the multiplication problems. However, the math might be harder to solve for younger students, and getting consent from a parent or guardian would be an extra measure to take.

Even though the results were not significant, it seems unfamiliar music such as the metal, produced the best results for solving a significant amount of multiplication problems. But since accuracy is more valued in math problems, silence would be the best condition, as well as for the word searches. Silence did not involve having to split one's concentration, since the only thing to focus on was the task. Metal music was shown the best genre probably because it was the least recognized, and the rhythm of each song was less repetitive and a faster tempo than the pop and classical. In the future, maybe different tests or activities that students do could be timed or measured for accuracy during certain background music to see if performance is improved, as well as involving lyrical or songs or different tempos as shown in other previous studies.

References

Cassidy, G., & Macdonald, R. (2009). The effects of music choice on task performance: A study of the impact of self-selected and experimenter-selected music on driving game performance and experience. *Musicae Scientiae, 13*(2), 357-386. doi:10.1177/102986490901300207

Dobbs, S., Furnham, A., & Mcclelland, A. (2011). The effect of background music and noise on the cognitive test performance of introverts and extraverts. *Applied Cognitive Psychology, 25,* 307-313. doi:10.1002/acp.1692

Jäncke, L., & Sandmann, P. (2010). Music listening while you learn: No influence of background music on verbal learning. *Behavioral and Brain Functions, 6*(1), 1-14. doi:10.1186/1744-9081-6-3

Kang, H. J., & Williamson, V. J. (2013). Background music can aid second language learning. *Psychology of Music, 42*(5), 728-747. doi:10.1177/0305735613485152

Thompson, W. F., Schellenberg, E. G., & Letnic, A. K. (2011). Fast and loud background music disrupts reading comprehension. *Psychology of Music, 40*(6), 700-708. doi:10.1177/0305735611400173

Tze, P., & Chou, M. (2010). Attention drainage effect: How background music affects concentration in Taiwanese college students. *Journal of the Scholarship of Teaching and Learning, 10*(1), 36-46. Retrieved from: http://josotl.indiana.edu/article/view/1733

Yang, J., Mcclelland, A., & Furnham, A. (2015). The effect of background music on the cognitive performance of musicians: A pilot study. *Psychology of Music, 44*(5), 1202-1208. doi:10.1177/0305735615592265

Appendix A

Flier for Non-LPP Recruitment

Appendix B

Adult Consent Form

To verify students as 18 or older and if they will participate in the experiment
Informed Consent Form
I, _____ (print name), understand that I will be taking part in a research project that requires me to complete word search puzzles and multiplication problems in silence and while listening to different genres of music, and taking a survey about how music is included in my everyday life. I understand that I should be able to complete this project within 55 minutes. I am aware that I am free to refuse to listen to the music, not do the activities, and skip any questions in the survey if I feel uncomfortable with. I am aware that my participation in this study is voluntary and that I may choose to withdraw from the study at any time without any penalty or prejudice. I should not incur any penalty or prejudice because I cannot complete the study. I understand that the information obtained from my responses will be analyzed only as part of aggregate data and that all identifying information will be absent from the data in order to ensure anonymity. I am also aware that my responses will be kept confidential and that data obtained from this study will only be available for research and educational purposes. I understand that any questions I may have regarding this study shall be answered by the researcher(s) involved to my satisfaction. Finally, I verify that I am at least 18 years of age and am legally able to give consent.

_____ Date: _____
(Signature of participant)

_____ Date: _____
(Signature of researcher obtaining consent)

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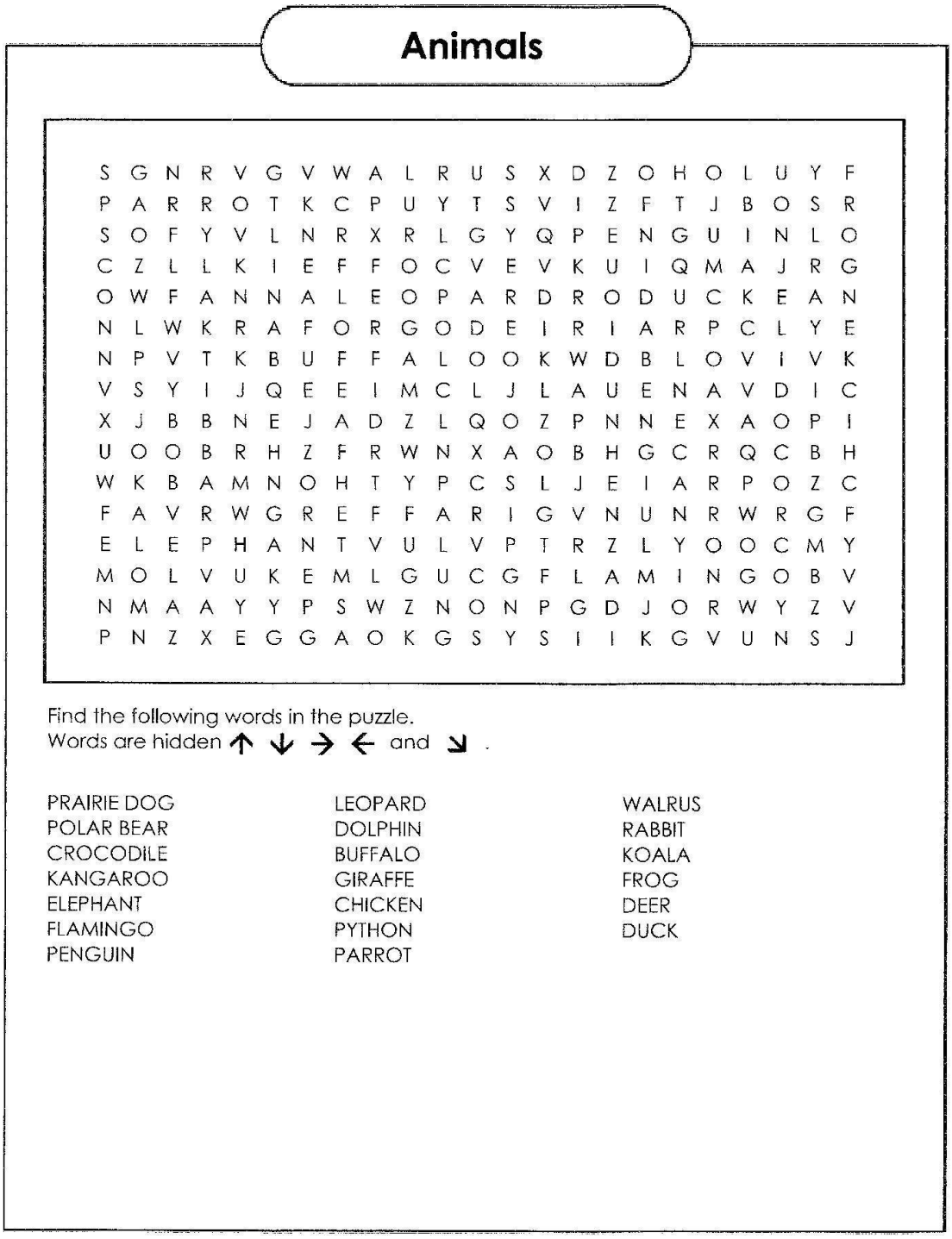
Appendix C

Animal Word Search



Animals

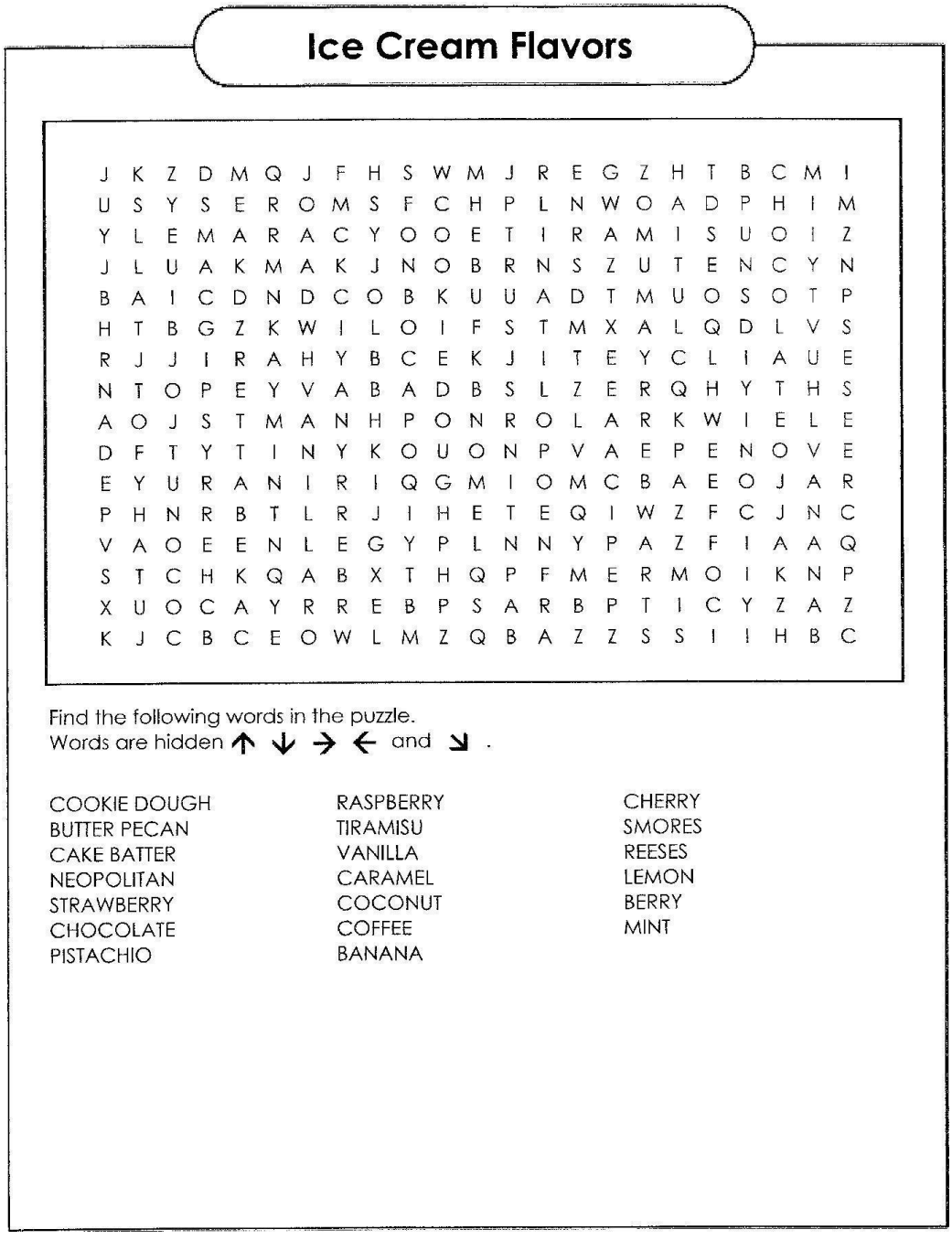
S G N R V G V W A L R U S X D Z O H O L U Y F
P A R R O T K C P U Y T S V I Z F T J B O S R
S O F Y V L N R X R L G Y Q P E N G U I N L O
C Z L L K I E F F O C V E V K U I Q M A J R G
O W F A N N A L E O P A R D R O D U C K E A N
N L W K R A F O R G O D E I R I A R P C L Y E
N P V T K B U F F A L O O K W D B L O V I V K
V S Y I J Q E E I M C L J L A U E N A V D I C
X J B B N E J A D Z L Q O Z P N N E X A O P I
U O O B R H Z F R W N X A O B H G C R Q C B H
W K B A M N O H T Y P C S L J E I A R P O Z C
F A V R W G R E F F A R I G V N U N R W R G F
E L E P H A N T V U L V P T R Z L Y O O C M Y
M O L V U K E M L G U C G F L A M I N G O B V
N M A A Y Y P S W Z N O N P G D J O R W Y Z V
P N Z X E G G A O K G S Y S I I K G V U N S J

Find the following words in the puzzle.
Words are hidden ↑ ↓ → ← and ↘ .

PRAIRIE DOG
POLAR BEAR
CROCODILE
KANGAROO
ELEPHANT
FLAMINGO
PENGUIN
LEOPARD
DOLPHIN
BUFFALO
GIRAFFE
CHICKEN
PYTHON
PARROT
WALRUS
RABBIT
KOALA
FROG
DEER
DUCK

Appendix D

Ice Cream Flavors Word Search



Ice Cream Flavors

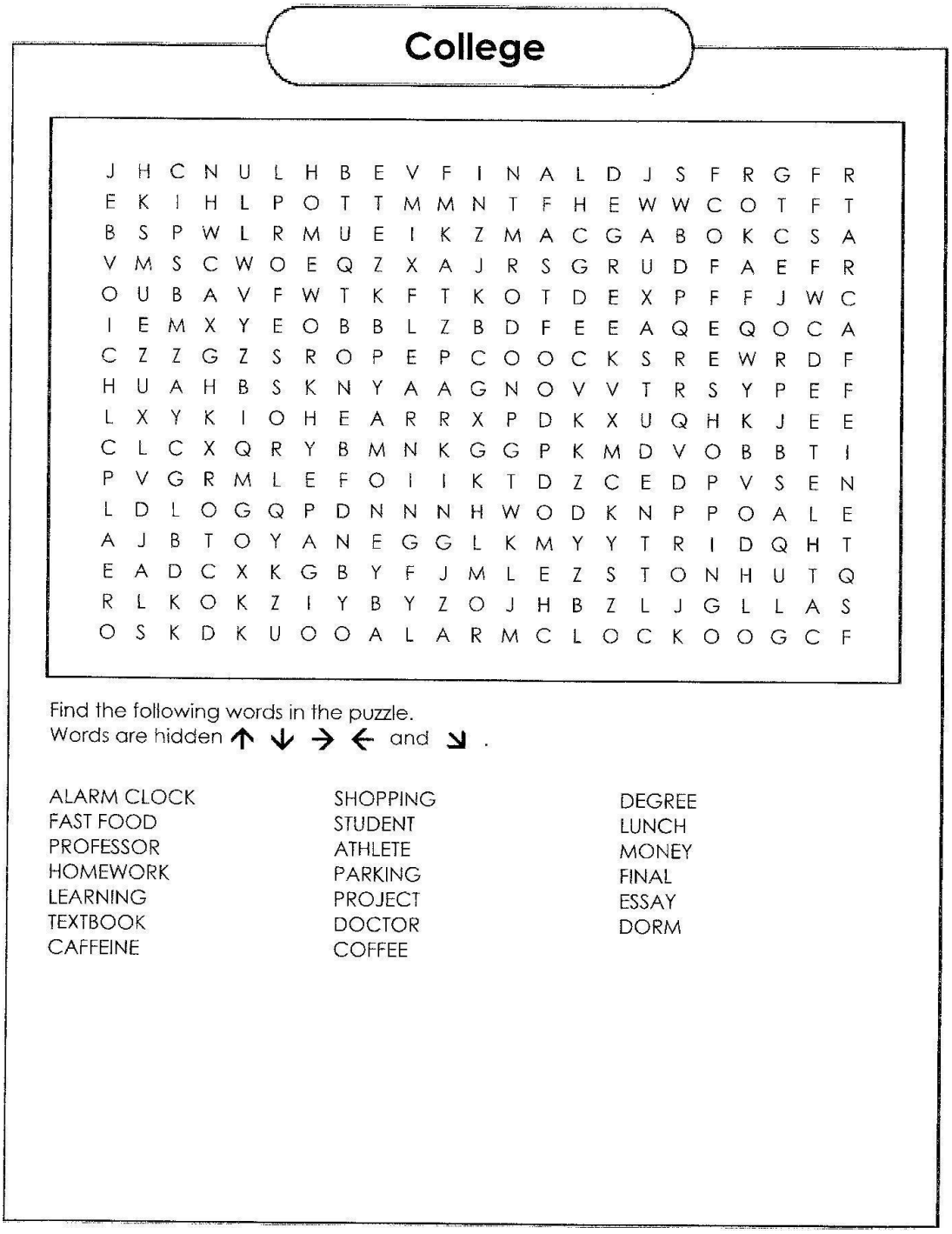
J K Z D M Q J F H S W M J R E G Z H T B C M I
U S Y S E R O M S F C H P L N W O A D P H I M
Y L E M A R A C Y O O E T I R A M I S U O I Z
J L U A K M A K J N O B R N S Z U T E N C Y N
B A I C D N D C O B K U U A D T M U O S O T P
H T B G Z K W I L O I F S T M X A L Q D L V S
R J J I R A H Y B C E K J I T E Y C L I A U E
N T O P E Y V A B A D B S L Z E R Q H Y T H S
A O J S T M A N H P O N R O L A R K W I E L E
D F T Y T I N Y K O U O N P V A E P E N O V E
E Y U R A N I R I Q G M I O M C B A E O J A R
P H N R B T L R J I H E T E Q I W Z F C J N C
V A O E E N L E G Y P L N N Y P A Z F I A A Q
S T C H K Q A B X T H Q P F M E R M O I K N P
X U O C A Y R R E B P S A R B P T I C Y Z A Z
K J C B C E O W L M Z Q B A Z Z S S I I H B C

Find the following words in the puzzle.
Words are hidden ↑ ↓ → ← and ↘ .

COOKIE DOUGH
BUTTER PECAN
CAKE BATTER
NEOPOLITAN
STRAWBERRY
CHOCOLATE
PISTACHIO
RASPBERRY
TIRAMISU
VANILLA
CARAMEL
COCONUT
COFFEE
BANANA
CHERRY
SMORES
REESES
LEMON
BERRY
MINT

Appendix E

College Word Search



College

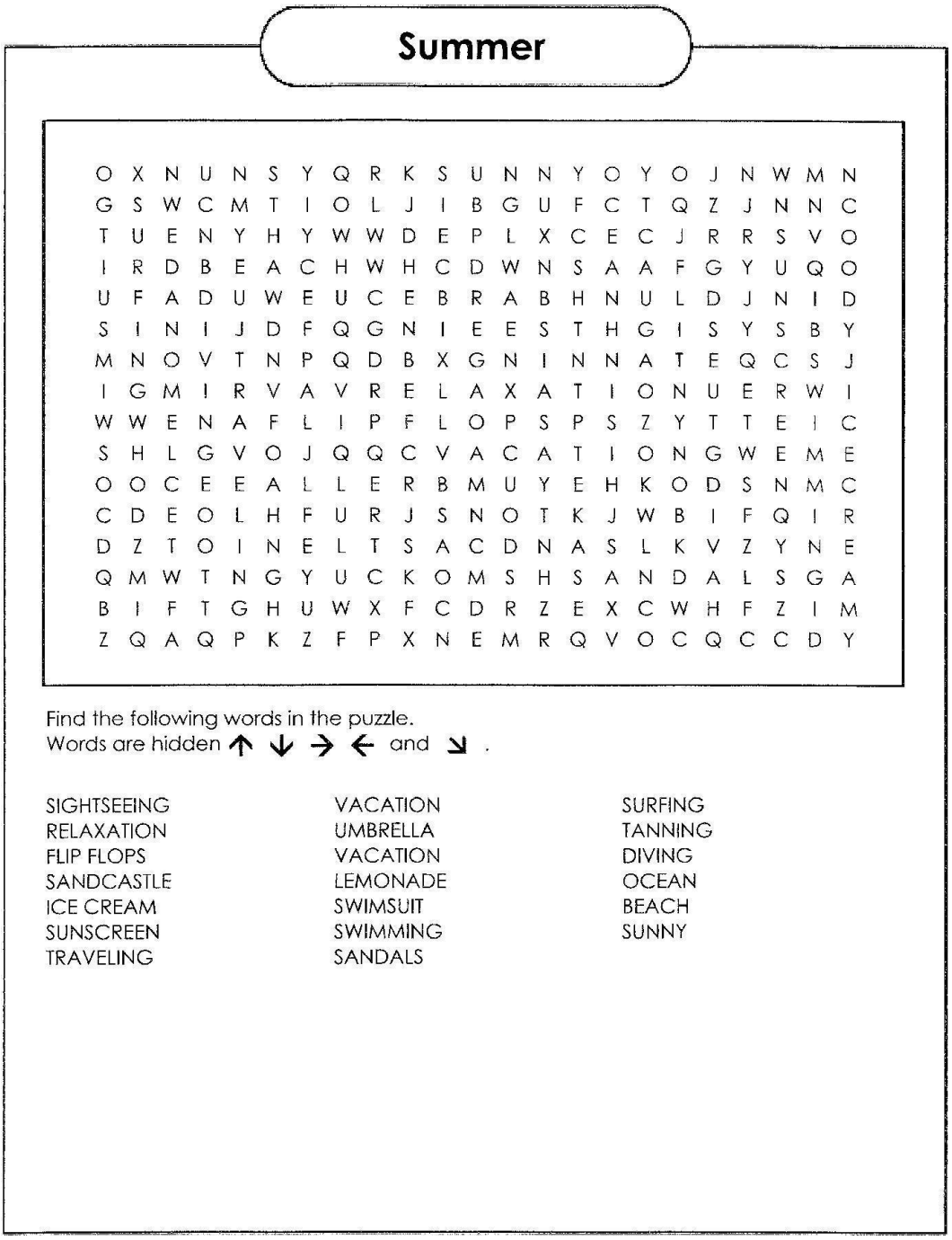
J H C N U L H B E V F I N A L D J S F R G F R
E K I H L P O T T M M N T F H E W W C O T F T
B S P W L R M U E I K Z M A C G A B O K C S A
V M S C W O E Q Z X A J R S G R U D F A E F R
O U B A V F W T K F T K O T D E X P F F J W C
I E M X Y E O B B L Z B D F E E A Q E Q O C A
C Z Z G Z S R O P E P C O O C K S R E W R D F
H U A H B S K N Y A A G N O V V T R S Y P E F
L X Y K I O H E A R R X P D K X U Q H K J E E
C L C X Q R Y B M N K G G P K M D V O B B T I
P V G R M L E F O I I K T D Z C E D P V S E N
L D L O G Q P D N N N H W O D K N P P O A L E
A J B T O Y A N E G G L K M Y Y T R I D Q H T
E A D C X K G B Y F J M L E Z S T O N H U T Q
R L K O K Z I Y B Y Z O J H B Z L J G L L A S
O S K D K U O O A L A R M C L O C K O O G C F

Find the following words in the puzzle.
Words are hidden ↑ ↓ → ← and ↘ .

ALARM CLOCK
FAST FOOD
PROFESSOR
HOMEWORK
LEARNING
TEXTBOOK
CAFFEINE
SHOPPING
STUDENT
ATHLETE
PARKING
PROJECT
DOCTOR
COFFEE
DEGREE
LUNCH
MONEY
FINAL
ESSAY
DORM

Appendix F

Summer Word Search



Summer

O X N U N S Y Q R K S U N N Y O Y O J N W M N
G S W C M T I O L J I B G U F C T Q Z J N N C
T U E N Y H Y W W D E P L X C E C J R R S V O
I R D B E A C H W H C D W N S A A F G Y U Q O
U F A D U W E U C E B R A B H N U L D J N I D
S I N I J D F Q G N I E E S T H G I S Y S B Y
M N O V T N P Q D B X G N I N N A T E Q C S J
I G M I R V A V R E L A X A T I O N U E R W I
W W E N A F L I P F L O P S P S Z Y T T E I C
S H L G V O J Q Q C V A C A T I O N G W E M E
O O C E E A L L E R B M U Y E H K O D S N M C
C D E O L H F U R J S N O T K J W B I F Q I R
D Z T O I N E L T S A C D N A S L K V Z Y N E
Q M W T N G Y U C K O M S H S A N D A L S G A
B I F T G H U W X F C D R Z E X C W H F Z I M
Z Q A Q P K Z F P X N E M R Q V O C Q C C D Y

Find the following words in the puzzle.
Words are hidden ↑ ↓ → ← and ↘ .

SIGHTSEEING
RELAXATION
FLIP FLOPS
SANDCASTLE
ICE CREAM
SUNSCREEN
TRAVELING
VACATION
UMBRELLA
VACATION
LEMONADE
SWIMSUIT
SWIMMING
SANDALS
SURFING
TANNING
DIVING
OCEAN
BEACH
SUNNY

Appendix G

Multiplication Packet A

3 pages total of 100 total different multiplication problems

4

Name: _____ Date: _____

Multiplication Worksheets

53 x58	43 x28	95 x40	20 x57	98 x65
85 x45	12 x32	39 x16	34 x77	74 x13
31 x16	93 x18	90 x42	85 x30	42 x22
59 x60	64 x68	10 x35	64 x30	19 x86
71 x97	88 x28	52 x47	13 x41	36 x73
79 x20	16 x44	85 x92	19 x28	57 x64
25 x23	18 x12	51 x55	52 x86	79 x84

Appendix H

Multiplication Packet B

3 pages total of 100 total different multiplication problems

B

Name: _____ Date: _____

Multiplication Worksheets

46 x68	69 x59	50 x83	63 x43	12 x92
55 x97	74 x25	35 x96	34 x77	45 x49
54 x47	82 x34	31 x82	56 x51	77 x40
29 x32	71 x21	79 x50	63 x12	68 x32
39 x45	85 x15	38 x53	49 x88	85 x96
24 x54	25 x84	62 x78	70 x77	69 x91
69 x19	57 x13	64 x79	13 x48	80 x92

Appendix I

Multiplication Packet C

3 pages total of 100 total different multiplication problems

C

Name: _____ Date: _____

Multiplication Worksheets

~~84~~ x85 _____	85 x35 _____	63 x58 _____	83 x98 _____	40 x42 _____
87 x85 _____	73 x56 _____	58 x60 _____	26 x29 _____	46 x76 _____
92 x19 _____	54 x86 _____	34 x17 _____	13 x38 _____	40 x69 _____
11 x17 _____	27 x89 _____	68 x75 _____	20 x22 _____	97 x66 _____
67 x93 _____	86 x53 _____	46 x74 _____	39 x42 _____	57 x26 _____
32 x60 _____	72 x50 _____	24 x79 _____	24 x19 _____	95 x15 _____
79 x13 _____	95 x58 _____	33 x14 _____	99 x24 _____	56 x85 _____

Appendix J

Multiplication Packet D

3 pages total of 100 different multiplication problems

D

Name: _____ Date: _____

Multiplication Worksheets

88 x52	13 x49	81 x71	42 x65	64 x87
34 x36	25 x96	72 x68	76 x17	30 x55
88 x66	32 x49	34 x41	49 x81	42 x44
80 x26	73 x78	12 x22	53 x32	72 x11
50 x60	76 x50	73 x37	73 x68	89 x80
93 x18	53 x95	45 x55	70 x93	63 x11
89 x50	44 x40	51 x52	89 x64	66 x60

Appendix K

Music Usage and Opinion Survey

1. How old are you? _____

2. What is your favorite genre of music? Why?

3. Where do you listen to music the most (in the car, bedroom, outside, etc.)?

4. What devices do you use to listen to music (phone, radio, etc.)?

5. What sources do you get your music from (radio, apps, CDs, etc.)?

6. Do you use music for specific activities?

YES NO (please skip to question 8)

7. The following section will list certain activities to which music is commonly used in the background. Circle YES or NO if you do this activity while listening to music, and please list which genre(s) of music you listen to for the activity. There will also be an additional option to write in any activity or activities you commonly do with background music if they are not in one of the questions listed.

a. Do you listen to background music for studying? YES or NO

If yes, which genre(s)?

b. Do you listen to background music while exercising? YES or NO

If yes, which genre(s)?

c. Do you listen to background music while cooking? YES or NO

If yes, which genre(s)?

d. If there are any other activities you do while listening to background music, please list them below as well as the genre(s) associated with the activities.

8. Were any of the genres of music you listened to today distracting or not to your liking?

YES or NO

9. If YES, which genre was distracting or not to your liking?

CLASSICAL POP HEAVY METAL

10. Please explain why you found it distracting or not to your liking.

11. Which genre(s) did you prefer the most?

CLASSICAL POP HEAVY METAL

12. Were any of the songs you heard today familiar or recognizable? If so, please list the song(s) and/or from which genre you recognized the song(s).

Appendix L

Thank You Letter

Thank you for participating in this study. The present study was conducted in order to determine whether different genres of music and if the presence of music affect a person's performance on word puzzle finding and completing multiplication problems. The hypothesis is that having no background music will produce more positive results than any background music, and that more words would be found as well as more multiplication problems would be completed (correctly) during classical music over pop and heavy metal. This information can help us and others figure out if music is a useful tool in increasing productivity in learning and working at jobs.

Please note that we are not interested in your individual results; rather, we are only interested in the overall findings based on aggregate data. No identifying information about you will be associated with any of the findings, nor will it be possible for us to trace your responses on an individual basis.

If you are interested in obtaining the final results of this study based on aggregate data, or if you have any questions or concerns regarding any portion of this study, do not hesitate to let us know now or in the future. Results will be confirmed by early December. Our contact information is found at the bottom of this letter.

Thank you again for your valuable contribution to this study.

Sincerely,

Principal Investigator:

Roberta Kerosevic 314-835-8121 (rk585@lionmail.lindenwood.edu)

Supervisor:
Dr. Michiko Nohara-LeClair 636-949-4371 (mnohara-leclair@lindenwood.edu)

Difference between Detecting Emotional and Non-Emotional Lies

David De la Cruz[12]

There are various approaches currently used to detect deception. While many of those approaches encounter different flaws, there is a constant factor that could affect lie detection, intuition. Intuition allows any person to detect some lies, but it also disrupts others, including trained professionals, from accurately detecting deception. When individuals communicate between each other they are able to experience and understand what others are feeling through empathy. Without realizing, people are able to use their intuition, empathy, and emotions to unconsciously detect some deception. However, truth tellers and liars could experience the same emotions regardless of the veracity of their statement. Since there are many emotions that are displayed by individuals by communicating, lie detectors are overwhelmed with different signals that affect their accuracy. How much does unconscious lie detection affect people's ability to detect lies? In this study people's ability to detect lies will be assess by comparing individual's accuracy when detecting the veracity of statements that vary in the amount of emotions displayed. I hypothesize that people will be better at detecting deception from others if there is a lower display of emotions, because they will be able to concentrate on the statement and the few truthful or untruthful emotions displayed with it.

From small white lies to great deceptive schemes, lies exist in every part of the society. Being surrounded by lies, people constantly judge the veracity of other individuals' statements. From parents judging if their kids are being deceptive, to train professionals trying to detect deception, people unconsciously use their intuition to catch liars (Brinke, Stimson, & Carney, 2014). Even if trained professionals learn a different variety of methods to detect deception, the

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