



Spring 2023

Technical and Business Writing

SS 2007

Technical and Business Writing; SS2007
EAST NILES KAPACHICAMPUS

Resume & Cover Letters

Job & Internship Guide

A

well crafted resume can set you apart from other candidates. Strong resumes do more than summarize your educational background and work history; they emphasize the results of your efforts and draw clear parallels between your skills and experience and an employer's needs.

The 5 Steps of Resume Development

Step 1: Analyze the Position Description

Read the position descriptions thoroughly and then highlight all of the keywords which indicate required and preferred skills, abilities, attributes, and qualifications. If an employer is looking for someone who is innovative, punctual, and attentive to detail, consider using these same or similar words in your resume.

Because there are patterns within industries/fields, you may develop a strong resume template for a particular category of positions. Along these lines, it is also often appropriate to have multiple versions of your resume, which may vary in content and structure depending on your target.

Step 2: Generate a List of Accomplishments

Create an inventory of your accomplishments—tasks you enjoyed doing, did well, and are proud of. Include education/training, volunteer experience, jobs, projects, travel, group or team activities, and skills. There is no one formula for what to include in a resume—Your resume should uniquely reflect you! Focus on the outcomes of your efforts, including skills you have developed. Quantify your results if possible. Don't sell yourself short! Resumes are promotional tools.

Step 3: Identify Relevant Skill Areas

Frame your experience so it focuses on skills and achievements that are desirable for that particular position/field/industry. Make sure each accomplishment you list highlights a skill the employer is seeking, often listed in the position responsibilities and qualifications.

Remember **transferable skills**, skills you've developed that can be used in many different settings! If you are applying to your first position in a field/industry, consider in detail which skills you have developed (and how) from past experiences that may translate to this new environment.

Step 4: Write Descriptive Phrases

Using **action verbs** (see p. 18), write concise phrases to describe experiences that demonstrate your relevant skills. The accomplishments on your resume should ultimately be targeted to address an employer's needs. Do your best to place them in order of relevance with the most relevant information as close as possible to the top.

Step 5: Choose a Format

Within **one page**, aim to develop a focused, succinct marketing document that clearly communicates your value and

relevant experience and skills.

A **chronological resume** is the most commonly used resume format. Listing your experience in reverse chronological order (with the most recent experiences first), this resume format accommodates all industries and levels of experience, and is preferred by the majority of employers and on-campus recruiters. Because a chronological resume presents your experience from most recent (relevant) to least recent (relevant), this format works especially well for students and entry to mid-level applicants to demonstrate a vertical career progression. See p. 19-24 for examples of effective chronological resumes.

Although a chronological resume is often a safe bet for all levels, established professionals who have multiple gaps and/or unusually large gaps in their employment history, who are aspiring to make a career change into a new industry, or who want to promote a specific skillset may consider a skills/functional resume format or a hybrid/combination resume format as alternatives to the chronological resume format. If appropriate, established professionals may also move beyond a one-page resume.

While resume templates may be tempting, they tend to be inflexible; also, employers are often familiar with them and may perceive you as lacking ingenuity. Find a format that works for you, and use your own words to develop content that is unique to you.

The Resume Bullet: How To Say It

Resume bullets should describe your skills and accomplishments, reflecting the order or priority that the employer has stated in their position description and requirements. Write bullet points for jobs, internships, volunteer experiences and activities where you've developed skills. Consider how these bullet points highlight skills and experiences that match the position requirements. Action-oriented statements highlighting your accomplishments should use concrete language and could include:

- **What:** What task (transferable skill) did you perform? Use action verbs! (See p. 18)
- **Why:** Why did you perform this task? e.g. to fulfill a goal, serve a need or make your organization/company better?
- **How:** Specifically how did you perform this task? What equipment, tool, software program, or method did you use to accomplish this task?
- **Result:** What was the positive result you achieved or impact you made by performing this task (quantitative or qualitative)?
- **Adjectives:** Spice it up with descriptors; sell yourself... go for it!

Examples:

What: Created a brochure.

What and How: Created a brochure using InDesign.

What and Why: Created a brochure to generate customer interest in the company's new line of fall clothing.

What, Why, and Result: Created a brochure to generate customer interest in the company's new line of fall clothing, resulting in high praise from Director of Marketing.

Adding Adjectives: Created a colorful and eye-catching marketing brochure using InDesign to generate customer interest in the company's new line of fall clothing, resulting in high praise from Director of Marketing.

What: Tutored students.

What and How: Tutored students using a variety of methods to adjust to different learning styles.

What and Why: Tutored students to help them retain information and improve both grades and overall performance in Math and English.

What, Why, and Result: Tutored students to help them improve grades and overall performance; saw marked improvement over a three-month period in 100% of students.

Adding Adjectives:

- Tutored at-risk youth in Math and English; assessed learning styles of each student and creatively adjusted tutoring style based on results.
- Affected information retention and overall grade improvement in 100% of students tutored over a three month period.
- Acknowledged by Director for strong commitment to student success.

TOP 10 ATTRIBUTES EMPLOYERS SEEK ON CANDIDATE RESUMES:

1. Leadership
2. Ability to work in a team
3. Communication skills (written)
4. Problem-solving skills
5. Communication skills (verbal)
6. Strong work ethic
7. Initiative
8. Analytical/quantitative skills
9. Flexibility/adaptability
10. Technical skills

Source: *Job Outlook 2016*, National Association of Colleges and Employers

RESUME TIPS FOR FIRST-YEAR STUDENTS

- You may include work, leadership, and academic achievements from high school. By your third year in college, more recent experiences should replace those from high school.
- Don't worry about having limited work experience. Instead focus on transferable skills developed through other kinds of involvement or accomplishments.
- Your first "college resume" may require extra time to assemble. Expect to spend a few hours creating a rough draft, and make an appointment with a Career Counselor or see a Peer Advisor to review your document.
- Be patient with the process! Resumes are always a work in progress.

REFERENCES

REFERENCES TIPS:

- In almost all cases, you will NOT submit references with your resume. Instead bring them to your interviews to furnish upon request.
- For a polished look, use the same header style for your contact information on your reference sheet that you use for your resume and cover letter.
- Secure 3-5 references prior to interviews. References should be people who have supervised you in an academic or hands-on setting like a job, internship, or volunteer position. Friends, family, and well-known people who do not know you well are not good references—they can say little about your potential for success.

MICHELLE ANDERSON

1253 College Avenue, Berkeley, CA 92134
510.555.4457 • mander@berkeley.edu

REFERENCES

Deborah Smith
Director of Marketing
ADworks Corporation
2 Sacramento Plaza, Suite 2434
San Francisco, CA 94311
(415) 555-0477
deborah.smith@adworks.com

Philip Blass, PhD
Assistant Professor
University of California, Berkeley
Department of Psychology
3210 Tolman Hall
Berkeley, CA 94720
(510) 555-3175
pbllass@berkeley.edu

Sylvia Nunez
Tutoring Programs Coordinator
Berkeley Tutoring Center
695 College Ave.
Berkeley, CA 92431
(510) 555-4892

VERB LIST FOR RESUMES & LETTERS

More Verbs for Accomplishments

achieved
expanded
improved
pioneered
reduced (losses)
resolved (problems)
restored
spearheaded
transformed
operationalized

Management

administered
analyzed
assigned
attained
chaired
consolidated
contracted
coordinated
delegated
developed
directed
evaluated
executed
improved
increased
organized
oversaw
planned
prioritized
produced
recommended
reviewed
scheduled
strengthened
supervised

Communication

addressed
arbitrated
arranged
authored
collaborated
convinced
corresponded
developed
directed
drafted
edited
enlisted
formulated
influenced
interpreted
lectured
mediated
moderated
negotiated
persuaded
promoted
publicized
reconciled
recruited
spoke
translated
wrote

Research

clarified
collected
critiqued
diagnosed
evaluated
examined
extracted
identified
inspected
interpreted
interviewed
investigated
organized
reviewed
summarized
surveyed
systematized

Technical

assembled
built
calculated
computed
designed
devised
engineered
fabricated
maintained
operated
overhauled
programmed
remodeled
repaired
solved
upgraded

Teaching

adapted
advised
clarified
coached
communicated
coordinated
demystified
developed
enabled
encouraged
evaluated
explained
facilitated
guided
informed
instructed
persuaded
set goals
stimulated
trained

Financial

administered
allocated
analyzed
appraised
audited
balanced
budgeted
calculated
computed
developed
forecasted
managed
marketed
planned
projected
researched

Creative

acted
conceptualized
created
customized
designed
developed
directed
established
fashioned
founded
illustrated
initiated
instituted
integrated
introduced
invented
originated
performed
planned
revitalized
shaped

Helping

assessed
assisted
clarified
coached
counseled
demonstrated
diagnosed
educated
expedited
facilitated
familiarized
guided
motivated
referred
rehabilitated
represented

Clerical or Detail Oriented

approved
arranged
catalogued
classified
collected
compiled
dispatched
executed
generated
implemented
inspected
monitored
operated
organized
prepared
processed
purchased
recorded
retrieved
screened
specified
systematized
tabulated
validated

Words in **bold** are
especially good
for pointing out
accomplishments.

RESUME OUTLINE CHRONOLOGICAL FORMAT

Use an appropriate
email and voicemail.

YOUR NAME

Street Address, City, State Zip
student@berkeley.edu | (650) 453-5555 | linkedin.com/in/yourname

OBJECTIVE

An objective statement is optional. If included, it should be specific to the position you are applying for.

QUALIFICATIONS

- Number of years of relevant experience, noting skills gained
- An important accomplishment that directly relates to the job
- A quality or characteristic of yours that supports this goal

A Qualification or
Summary section is
optional. Use only if
you have significant
skills that relate to
the job description.

EDUCATION

University of California, Berkeley

Bachelor of Arts/Science, Name of Major

Minor or Concentration

Honors Thesis: "Title"

Overall GPA and/or Major GPA

Related Coursework: Course Title, Course Title, Course Title

Berkeley, CA
Expected Month Year

Previous Institution Name

Name of Degree/Diploma/Program or Summary of Coursework Completed

City, State/Country
Month Year

EXPERIENCE

Organization Name

Position Title

City State/Country
Month Year - Present

- Use bullet points to describe your accomplishments. Paragraphs can work as well, although bullets will lead the reader's eyes more easily.
- Always start your statement with "action verbs" add adjectives to emphasize
- State an accomplishment that demonstrates your skills in this field/position
- Illustrate a problem you solved using relevant skill(s) and the results
- Provide an example of when you used your skills to positively affect the organization, the bottom line, your boss, or your clients

Position Title

Month Year - Present

- If you have been involved in multiple positions within one organization, consider breaking out your positions to highlight your progression within the organization.

Organization Name

Position Title

City State/Country
Month Year - Present

- Be consistent with punctuation and format within each section.
- Use present tense verbs for current positions and past tense verbs for previous positions.

SKILLS

Language: Provide an accurate assessment of your proficiency (e.g. conversational, fluent, native) in any languages other than English.

Computer/Software/Programming: Consider how to best represent your familiarity, proficiency, or expertise in technical areas.

Laboratory: Consider including other relevant categories of skills, based on your background and the position you are applying for.

INTERESTS

Listing interests is optional. Interests may or may not be related to the position, but if included they may serve as a potential conversation starter and an opportunity to share other passions, hobbies, or ways you spend your time.



CHRONOLOGICAL RESUME



Anna Lee

333 University Ave., Berkeley, CA 94720 | (555) 555-6644 | student@berkeley.edu

OBJECTIVE

Full-time position as a financial analyst

If you include an objective, make it clear and concise.

A summary may be included if you have specific skills and experiences the job description asks for.

EDUCATION

University of California, Berkeley
Haas School of Business

Bachelor of Science, Business Administration (GPA: 3.64)

May 2016

SUMMARY OF QUALIFICATIONS

- Professional experience as intern in well-established financial services agency
- Strong background in research and analysis developed through leadership experience and business courses
- Extensive work on case projects in financial accounting and corporate finance classes
- Proficient in Excel, PowerPoint, and Bloomberg

EXPERIENCE

Investment Intern, BAE Financial Services, Orange, CA

May – August 2015

- Developed and implemented financial plans for individuals, businesses, and organizations by utilizing knowledge of tax and investment strategies, securities, insurance, pension plans, and real estate
- Prepared and submitted client's financial plan documentation; maintained contact with client, revising plan as required to reflect modified client needs or financial market changes
- Conducted research on various investment products to recommend the most suitable ones to clients

Case Competitions, Haas School of Business

August 2014 – May 2015

1st Place: Morgan Stanley Technology Investment Banking Case Competition, Fall 2014

- Conducted discounted cash flow and public comparables analyses to determine the best strategic recommendation for LinkedIn's IPO; analyzed competitive landscape, industry trends and IPO market

Finalist: Goldman Sachs Investment Banking Case Competition, Fall 2014

Financial Analysis Project, Financial Institutions and Markets class, UC Berkeley

Fall 2014

- Created comparable company analyses to identify financial opportunities.
- Performed market research to facilitate analysis of equity funds.
- Developed comprehensive investment portfolio strategy and presented to class of 35

LEADERSHIP

Treasurer, Undergraduate Finance Association

August 2014 – present

- Expertly manage cash funds and flow garnered from membership fees, ASUC allotment and annual events
- Actively attend weekly meetings, sharing information with peers about opportunities and activities surrounding careers in finance

Active Member, International Association of Business Communicators

August 2014 – present

ADDITIONAL SKILLS & INTERESTS

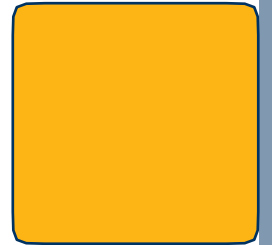
Computer: Bloomberg, Excel, Access, PowerPoint, Word, C++, HTML

Languages: Fluent in Mandarin

Interests: Avid vocalist, painter and photographer



CHRONOLOGICAL RESUME WITH PROJECT HIGHLIGHTS



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CHRONOLOGICAL RESUME



Jayden Hien Yoon

5555 Dwight Way, Berkeley, CA 94704
(916) 555-5555 | student@berkeley.edu

EDUCATION

University of California, Berkeley

12/15

Major: Bachelor of Science in Integrated Biology; emphasis in Human Biology

Minor: Chemistry; Theatre, Dance, and Performance studies

GPA: 3.54

Coursework: General Chemistry, Organic Chemistry, Biology, Biology of Human Reproduction, Comparative Endocrinology, Hormones and Behavior, Physics, Calculus

LAB SKILLS

Nuclear Magnetic Resonance
Mass Spectrometry
Gel Electrophoresis
Organic Synthesis

Thin Layer Chromatography
Polymerases Chain Reactions
Dissection

Include a summary which quickly showcases your skills for an employer.

EXPERIENCE

Chemistry Tutor

9/14-Present

Student Learning Center, UC Berkeley

- Work with a team of experienced students to tutor both individually and in groups in subjects such as General Chemistry and Organic Chemistry
- Prepare mock lectures to teach complex Organic chemistry reactions to Berkeley students
- Develop original problem sets to further illustrate concepts; well-received by students

Grader (Chemistry lab)

9/12-5/13

American River College, Rockland, CA

- Meticulously checked and graded over 100 lab books per week, paying close attention to details and returning to professor on time each week

VOLUNTEER

Volunteer, Urgent Care

Related volunteer work can show both applied knowledge and care for the community.

7/14-Present

San Francisco General Hospital, San Francisco

- Using care and compassion, assist healthcare providers and nursing staff with patient care
- Direct patients and their families to specific departments of the hospital, answering questions and making referrals to other departments
- Monitor the health conditions of patients in the waiting room and report any dangerous changes in the health or behaviors of the patients to nurses

Volunteer, Vitas Innovative Hospice Care

7/14-Present

Various locations, Berkeley

- Assist elders with their daily needs related to mobility, food-serving, and cleanliness
- Aid in emotional and spiritual support for patients with life-limiting illness and bereavement support for families
- Prepare weekly reports for Hospice Care regarding behavioral and physical changes of elders

Mongolian Community/Mission Service Trip

Summer 2012

Mongolia

- Collaborated with seminary students to understand and communicate with native speakers more effectively
- Worked with a team of 11 American and 9 Mongolian students to build tents and ranches for the Nomads
- Executed a variety of programs to engage and teach college students at Mongolian State University of Agriculture, taking initiative to connect and interact with them



CHRONOLOGICAL RESUME



Edward Pfaff

123 Main Street | Los Gatos, CA 95032 | EPfaff@berkeley.edu | www.linkedin.com/in/edwardpfaff/ | (408) 555-6757

EDUCATION

University of California, Berkeley

Bachelor of Arts, English, Minors in History of Art and French | GPA 3.79

Expected May 2016

Senior Thesis (in progress): Narrative Approaches in the Novels of Jane Austen

SUMMARY

- Well-honed research, writing and copyediting skills, with meticulous attention to detail
- Creative thinker who enjoys coming up with new and different ideas
- Social Media experience in Facebook, LinkedIn, YouTube, Twitter and Pinterest
- Strong work ethic, with ability to work well under tight timelines

You can include your LinkedIn profile link; be sure information is consistent with resume.

EXPERIENCE

Social Media Intern, SocialMedia.com, Hollywood, CA

June-August 2015

- Assisted with all facets of outreach including building and maintaining social identities and keeping up-to-date on social media trends. Performed internet research, target list creation, and database management
- Interacted regularly with core fans on message boards, video upload sites, and microblogging sites
- Contributed to the content and appearance of each account/profile and analyzed statistics and traffic of each social media account
- Improved monthly Facebook page viewership and membership by 14%

Event Planning Intern, UC Berkeley Leadership Programs

January-May 2015

- Worked with a team of five to plan Spring Conference attended by over 300 students; enhanced professional networking skills
- Coordinated, managed and hosted Lunch with Leaders symposium attended by over 125 students.
- Designed and implemented creative marketing strategy, including press releases and local advertising

Using significant numbers helps emphasize the impact of your accomplishments

Production Intern, Media Match, San Francisco, CA

June-August 2014

- Evaluated prospective clients and talent agencies for commercial and industrial film projects
- Scheduled and coordinated auditions and interviews for performers and technical staff

Cashier & Server, Yogurt Park, Berkeley, CA

July-Nov 2014

- Delivered efficient and courteous customer service, addressed customer complaints and helped resolve employee conflicts
- Served frozen yogurt, handled cash transactions, stocked yogurt machines, and maintained store cleanliness
- Trained new employees how to use machines, serve yogurt and interact positively with customers

ACTIVITIES

Editor, Cal Literature & Arts Magazine (CLAM), UC Berkeley

Sept 2015-present

- Contribute to design, copy editing and production of bi-annual journal of poetry, prose and artwork comprised of submissions from undergraduate and graduate students
- Meet weekly with other editors and staff to review submissions and timelines, and plan events and fundraisers
- Publicize events to community using social media, flyers, posters, and ticket sales on campus
- Initiated advertisement sales as an additional source of revenue

OTHER SKILLS AND INTERESTS

Languages: Competent in written and spoken French

Interests: Drawing and painting landscapes



CHRONOLOGICAL RESUME



GRACE MENDOZA

5678 Dwight Way Apt #101 • Berkeley, CA 94704 • (858) 555-5555 • student@berkeley.edu

EDUCATION

University of California, Berkeley

Bachelor of Arts, Psychology (GPA: 3.73)

Bachelor of Arts, Cognitive Science (GPA: 3.40)

Expected May 2017

PROFESSIONAL SUMMARY

- 3 years of experience leading diverse groups of students through campus and community leadership roles
- Well-developed advising and helping skills; experienced serving broad range of adult and student populations
- Teaching and workshop facilitation experience; ability to develop lesson plans and assess learning outcomes
- Excellent with Microsoft Word, Excel, PowerPoint, Outlook; proficient with Filemaker and Adobe Photoshop

Include a summary which quickly showcases your skills for an employer.

RELEVANT EXPERIENCE

Job Development Intern

Jul 2015-Present

Youth Employment Initiatives, San Francisco

- Collaborate with staff in designing and delivering curriculum and training programs and presentations on various employment and business topics to a diverse adult population and the community at large
- Perform research and analysis on current employment and hiring policies, issues, and market trends
- With staff case managers, visited hiring managers in variety of SF-based companies to create hiring relationships
- Participate in client case review sessions, offering ideas and strategies for increasing job placements

Psychology Research Assistant

Sept 2014- June 2015

Relationships and Social Cognition Lab with Professor Ayduk, UC Berkeley

- Recruited and interacted extensively with research participants while safeguarding their confidentiality
- Operationalized participants' verbal and non-verbal behavior into quantitative data
- Performed scrupulous data collection, data entry and data analysis of research procedures and results
- Expertly managed databases such as Qualtrics, Psychology RPP, and Survey Monkey

Student Advisor

Aug 2012 - June 2013

City College of San Francisco, Extended Opportunity and Programs Services (EOPS)

- Introduced and led educational, financial, and leadership workshops for new students
- Advised students on academic matters and made referrals to appropriate programs and staff

ADDITIONAL EXPERIENCE

Administrative Assistant

January 2014- Present

Department of English, UC Berkeley

- Provide excellent administrative support to 57 faculty and 11 staff with demonstrated ability to improvise and meet demanding deadlines
- Respond to a high volume of telephone and walk-in inquiries with friendliness and professionalism, referring clients to appropriate resources
- Use Filemaker database to manage book orders and general record keeping
- Pioneered method to store print and electronic documents properly for future reference; improved efficiency

LANGUAGES & TRAVEL

- Fluent in both written and spoken Spanish
- Studied abroad in Madrid, Spain, Spring 2016, enhancing Spanish skills and cross-cultural sensitivity



HYBRID RESUME



Janelle Davis

123 East Street • San Leandro, CA 94578 • (510) 555-5555 • jdavis@berkeley.edu

EDUCATION

UNIVERSITY OF CALIFORNIA, BERKELEY

Bachelor of Arts, Molecular and Cell Biology

Minor in Psychology

(GPA: 3.70)

Expected 5/16

This hybrid resume combines strengths of both skills and chronological resume formats.

EXPERIENCE

RESEARCH / WRITING

Research Assistant, Comparative Endocrinology Lab, UC Berkeley

Planned, organized and carried out long-term and short-term research projects with minimal supervision; quickly learned complex laboratory procedures; analyzed and studied evolution of hormones, developing expertise in metabolic pathways of thyronines

8/14-5/15

Research Assistant, Children's Hospital of Oakland

Successfully executed molecular biology experiments involving DNA sequencing and gene analysis; maintained detailed records for procedural and statistical purposes; gained significant independent research and writing experience

9/13-5/14

Campus Relations Intern, UC Berkeley Office of Public Affairs

Compiled Fellow articles from a variety of journals, magazines and newspapers; used InDesign to create pages; developed efficient proofreading methods

1/13-5/13

TEACHING

Teaching Intern, Break the Cycle, Berkeley, CA

Improved 1st grade students' math skills through consistent and creative teaching and curriculum development; motivated 15 underachieving students toward success in their annual district exams; designed individual curricula, focusing attention on methods that work well for specific population

5/15-8/15

Tutor and Teacher's Aide, Edna Brewer School, Oakland, CA

Conceptualized and implemented a yearlong project for ESL students resulting in a journal of autobiographical works for use as a learning tool for other ESL instructors, historical archive, and a source of inspiration for other ESL students; drafted proposal to finance project, resulting in full grant support

9/13-12/13

LEADERSHIP

Rush Chairperson, Chi Omega Sorority, UC Berkeley

Coordinated team of 10 in planning sorority recruitment; implemented marketing strategies promoting the benefits of membership, resulting in chapter membership increasing by 35%; efficiently managed budget for Rush preparation week and Rush week

9/14-12/14

ACTIVITIES

Saxophone, UC Berkeley Jazz Band

Shortstop, UC Berkeley Club Baseball Team

1/14-present

8/13-12/14

COVER LETTERS

A well written cover letter should always accompany your resume or application. Its purpose is to introduce yourself, expand on the experience in your resume as it relates to the job description, and explain why you are interested in that specific company/organization.

A good cover letter should:

- Open with a compelling paragraph that tells a story and catches the reader's attention.
- Connect your experiences and qualifications with the desired qualifications of the employer.
- Include specific information about why you want to work for the employer and industry.
- Exemplify clear and concise writing skills with NO grammar/spelling errors.
- Demonstrate your knowledge of the position AND the company.

Cover Letters for Job or Internship Listings

• Know the employer

Research the employer's organization to see how your experience, skills, and abilities meet its needs. In your cover letter, show why you are a good fit. Send the letter to a specific person whenever possible; otherwise, use "Dear Hiring Manager," "Dear Members of the Selection Committee," or "Dear Hiring Team."

• Analyze the job description

Carefully review the position responsibilities and qualifications and design your cover letter to match these as much as possible. Sometimes position listings are vague. In these cases, draw from your experience of similar positions to infer which skills and abilities might be required or research similar positions online.

• Analyze your background

Think about your background in relation to the position responsibilities and qualifications. Ask yourself, "What have I done that is similar to what this position entails?" Consider courses taken, classroom projects, work experience, summer jobs, internships, volunteer experience, extracurricular involvement, and travel. Be sure to indicate in the first paragraph what position you're seeking. If a specific person recommended you for or alerted you about the position, include their name and title up front. For example "Jason Ryner, your Marketing Manager, recommended that I apply for this position."

Prospecting Letters

If you are inquiring about possible openings, you are sending an Inquiry or Prospecting Letter. Address your letter to a specific individual, usually the person who supervises the functional area where you'd like to work. Be as specific as possible about the type of position that interests you. Ideally, your research will reveal the job titles used by this employer. If not, use generic job titles commonly understood in the field.

COVER LETTER CHECKLIST

STOP! Don't submit your cover letter until you have completed the following:

- ☐ Write an original targeted cover letter for each employer and position.
- ☐ State in the first sentence why you are writing and why you are interested.
- ☐ Show that your career goals are aligned with both the position and the organization.
- ☐ Make your points succinctly; every point should support your readiness to contribute.
- ☐ Proofread for typos and accuracy of contact information. Have another set of eyes review it, too.
- ☐ Run spell check before sending your final copy, but remember that it does not catch everything.
- ☐ Follow up with the employer if you hear nothing after 2-3 weeks. Inquire if any further information is needed and reiterate your interest.

BE CAREFUL NOT TO...

- Make your introduction long winded or forget to include your job objective to cause confusion about what you're applying for.
- Forget to proofread your letter or use spell check!
- Write a great deal about your experiences without explaining why they are relevant. Do provide details that will let the employer know that you understand what their company does or what the job entails.
- Write more than one page, forcing employers to hunt for your qualifications.
- Explain what the employer can do for you, instead of what you can do for them.
- Send the same generic cover letter to all employers.

COVER LETTER

Suggested Layout

The following is intended as a guide. Cover letters should be unique and original.

YOUR NAME
Email - Phone Number - Address

Month Date, Year

Employer or HR Manager's Name
Company Name
Employer Street Address
City, State Zipcode

The simplest way to lay out your cover letter is to align all text to the left. Not only is it simple, but it looks professional and polished.

Dear Mr./Ms./Dr. Last Name of Addressee:

Opening Paragraph

State the position you are applying for, how you found out about it, and ask for consideration based on your skills and experiences you have to offer. If you were referred by someone (ie: someone you know at the company, a recruiter you met at a career fair, etc) state that here. Make a general statement summarizing what qualifies you most for the job.

2nd Paragraph

In this section, you want to build a direct connection between the company's needs and your background and skills. Stress what you have to offer, avoid talking about what you want from them. Identify those parts of your experience that will interest THIS employer (refer to the job description if possible). You can draw attention to relevant course work, special projects and campus activities if they show direct relationship to this position. Do not restate what's in your resume, rather expand upon a specific project or accomplishment.

3rd Paragraph – Optional

Convince the employer that you have the personal qualities, passion and motivation to succeed at this specific company. Relate your interests/passion to what you know about the company. (Convince the employer that you not only have the skills to do well at the job, but a vested interest in the company, the industry, and the work itself.)

Closing Paragraph

Restate your interest in this position and how your unique qualifications fit the position. Request an interview, or tell the reader that you will contact him/her soon in order to schedule a mutually convenient time to meet. Thank the reader for his/her time and consideration.

Sincerely,

Your Signature

Type Your Name

COVER LETTER

Basic Sample for Existing Position

Marty Lewis

345 Channing Way Apt #101 • Berkeley, CA 94704 • 650.555-5555 • student@berkeley.edu

October 1, 2016

Patricia Scott
Director, Human Resources
Yahoo!
896 Mission College Blvd.
Santa Clara, CA 95003

Dear Ms. Scott:

I am excited to submit my application for the Training Specialist position I saw listed in Handshake. I am confident that my relevant education, experience and skills related to this position merit your consideration.

As you can see on my resumé, I will complete my bachelor's degree in Business Administration at UC Berkeley in May 2017. While this degree has provided me with a strong background in many aspects of business, it has also given me the opportunity to demonstrate my abilities through practical experience. As a Training Department Intern with UCSF, I was responsible for a new computer software education program. This project allowed me to develop and refine my training and organizational skills while designing a program to teach basic software applications to users with limited experience working with computers. The success of this program has been so overwhelming that the department has integrated it into their new staff training course.

Through my experiences at UCSF, it became clear to me that training and development is an incredible passion of mine – whether I am facilitating or designing them, I aim to make all trainings innovative, effective and fun. Yahoo is known for being one of the best employers to work for in the world, in part because of its innovative, inclusive and welcoming training programs. For this reason, I am particularly excited to be applying for this position in hopes that I may have the opportunity to contribute to such a reputable team in creating and providing top quality employee training.

Although the enclosed resumé thoroughly outlines my education and experience, I would appreciate the opportunity to demonstrate in an interview my knowledge of employee training and development, initiative, and interpersonal skills. You can contact me at (650)555-5555 to set up an interview. I look forward to hearing from you soon.

Sincerely,

Marty Lewis

Marty Lewis

Although it's more assertive to indicate that you will call, it's best to wait for a call if the employer specifically states "no calls" in their listing.

COVER LETTER

prospecting for a position

333 College Avenue
Berkeley, CA 94765
susantdavis@berkeley.edu
(555) 555-7777

December 1, 2016

Mr. Earl Jones
Goodworks Agency
234 E Santa Clara Street
San Jose, CA 94567

Dear Mr. Jones:

I learned about Goodworks in the process of researching nonprofits online. I have been seeking an organization whose mission matches my desire to help low-income clients with practical matters and emotional support, and was inspired by Goodworks' range of services and successful track record. I am writing to see whether you would be interested in hiring an intern this summer.

I am a junior at UC Berkeley, pursuing my BA in Sociology and a Spanish Minor, and considering an eventual career in social work or nonprofit management. Since August, I have been conducting HIV test counseling sessions as a volunteer at the Berkeley Free Clinic. It has been rewarding working with people from diverse backgrounds, many of whom are struggling to meet basic life needs, and to use my Spanish speaking skills. I would love to apply and further develop my counseling skills while making a positive contribution at Goodworks.

I will be available to work up to 20 hours a week this coming summer and would welcome the opportunity to meet with you to discuss the possibility of interning with you. I will follow up on this letter in a week to see if we can set up a time. Thank you very much for your attention.

Sincerely,

Susan T. Davis

Susan T. Davis

Since you don't have a mutual contact, you have to find another way to form a bond with the reader. Establish that you are interested specifically in this organization and explain why you are targeting them.

Keep the letter short and to the point. The reader is probably very busy, and the letter is just to get his attention. Be assertive in the closing.

COVER LETTER

T-letter - a high impact alternative format

The following is intended as a guide. Your cover letters should be unique, original, and tailored for each job.

Freda Jones
2440 Bancroft Way, #204 • Berkeley, CA 94720 • (510) 999-9999 • fjones@berkeley.edu

April 1, 2016

Alan Smith
University Recruiting Lead
Widget Advisors
9999 University Circle
Menlo Park, CA 94025

Reference: Summer Analyst Intern (#a100009)

Dear Mr. Smith:

First paragraph
should be compelling
and answer two
questions: Why
them? Why you?

Every day as I traveled to school I passed a construction site where a fascinating building started to rise above the fence. It was so interesting I searched the Internet to find out the building's owner. I discovered an equally interesting company-Widget. I have been following Widget's story ever since and so was delighted and excited to see your posting for a Summer Analyst.

Based on my understanding at this stage I believe the following are important:

Quantitative Skills

Called a T-letter because
the white space looks like an
upper-case T.

I discovered I have an aptitude for numerical, analysis, data modeling and software tools while still in high school. I also discovered a skill at conveying complex concepts so that lay people understand. I have also led team efforts to win prizes in national case-based competitions.

Collaboration

When I started at Berkeley I joined the Widget Appreciation Club when it was defining itself. Everyone had lots of ideas and everyone was championing their own. I listened to all the ideas and then facilitated a group session to pull out the best of all the ideas. The result was everyone felt they had contributed to the Club's new direction and membership rose by over 300% over the following semester.

Fast Learner

Key words or phrases
taken from their
posting. Use their high
priority ones.

While at high school I helped out at a small local business. They were suffering from unreliable computer systems so, in addition to my regular work, I evaluated their needs and replacement options. I got the owner's go-ahead and learned the new system in a quarter of the time the supplier expected. I was then able to train the staff so the implementation was smooth and removed all the previous problems.

I view an internship as a two-way process. I'm certain I would learn a huge amount from you but I would also want to bring value to Widget Advisors and I look forward to discuss with what that value might be.

Sincerely,

Freda Jones

Freda Jones

Thank-You Letter after an Interview

Remember to obtain names, addresses, and phone numbers during your interview so that you can follow-up in writing.

After interviewing for a position, send a thank-you letter within 24 hours to the individuals who interviewed you. This courtesy may put you ahead of the competition. Make it businesslike and concise.

Include your name, mailing address, phone number, and e-mail address in the letterhead. Balance the content on the page. Include the date, followed by one or more blank lines, then the interviewer's name, company name, and mailing address.

In the first paragraph, thank the interviewer for the interview and clearly signify your interest in working for the company if the job is "right" for you. If the job is not for you, thank the interviewer and briefly indicate that the job does not fit your interests. Be careful making this decision, because you cannot professionally change your mind.

In the second paragraph, mention again your qualifications and include any positive qualities that you may have forgotten to mention at the interview.

Close the letter with a final thank you and express your interest in hearing from the interviewer and the company. Provide the interviewer with your phone number and e-mail address. If you prefer to have 32 more control of the communication, notify the interviewer/company of a specific time when you will follow your letter with a phone call.

Remember to make each thank-you letter a separate entity. Do not use form letters. Personalize the letter, so that the reader will get a positive feeling from the text. If you get a rejection, follow the above procedure. The positive value of your response may open up new doors to employment.

In cover letters, thank-you letters, and resumes, it is best to use the same kind and color of paper.

Send a similar thank-you letter to your employer after finalizing your plans for an internship, co-operative position, or full-time employment.

Follow-up Letter after an Initial Contact

Include your name, mailing address, phone number and e-mail address in the letterhead. Include the date, followed by one or more blank lines, then the recommended contact person's name, company name, and mailing address. Limit the content to one page and center it vertically.

Use "Dear" followed by Mr. or Ms. and then the recommended contact person's name as the salutation. If uncertain about the person's gender, use RE: followed by the subject of the correspondence instead of addressing the letter to a specific person, for example: "RE: Advertised Design Engineer Position in your Detroit Office."

In the opening paragraph, refer to the initial contact and express your appreciation for this contact. Mention what was discussed and what interested you. Be specific, giving examples that are professional and will make you distinctive. Use employer terminology and customize the letter to fit the job description. Use action verbs, write clearly and concisely, and use the pronoun “I” selectively. Be honest and positive. Include your degree and graduation date or the date you are available for employment.

In the second paragraph, summarize your skills and strengths, especially those that piqued the interest of the company contact person. Give details of your conversation that are relevant to the company’s needs. Remember that your resume is attached, so limit this paragraph to additional skills and accomplishments or those experiences that are unique to this position or the company. Descriptions of actions and experiences that demonstrate your skills are more effective than generalizations. For example, “Last semester I traveled to Costa Rica to study Food Safety. While I was there, I assisted an engineering professors with the installation of water treatment systems at schools and healthcare facilities in rural areas that did not have electricity.”

Make the closing paragraph active by taking the initiative to contact the company. Indicate a date that you will follow-up. Remember, you have two contact names to follow-up with, your initial contact and the recipient of this letter.

Close the letter using “Sincerely,” followed by four blank lines, and then your name. Sign the letter just above your printed name.

Type “c:” followed by your initial contact person’s name. This signifies that this person has been sent a copy of this letter, so remember to do so.

Type the word “Enclosure” if you have enclosed your resume or other documents.

How to Read a Scientific Article

Mary Purugganan, Ph.D. maryp@rice.edu

Jan Hewitt, Ph.D. jhewitt@rice.edu

Cain Project in Engineering and Professional Communication

Reading a scientific article is a complex task. The *worst* way to approach this task is to treat it like the reading of a textbook—reading from title to literature cited, digesting every word along the way without any reflection or criticism. Rather, you should begin by skimming the article to identify its structure and features. As you read, look for the author's main points. Generate questions before, during, and after reading. Draw inferences based on your own experiences and knowledge. And to really improve understanding and recall, take notes as you read. This handout discusses each of these strategies in more detail.

1. Skim the article and identify its structure.

Most journals use a conventional IMRD structure: An abstract followed by Introduction, Methods, Results, and Discussion. Each of these sections normally contains easily recognized conventional features, and if you read with an anticipation of these features, you will read an article more quickly and comprehend more.

Features of Abstracts

Abstracts usually contain four kinds of information:

- purpose or rationale of study (why they did it)
- methodology (how they did it)
- results (what they found)
- conclusion (what it means)

Most scientists read the abstract first. Others—especially experts in the field—skip right from the title to the visuals because the visuals, in many cases, tell the reader what kinds of experiments were done and what results were obtained. You should probably begin reading a paper by reading the abstract carefully and noting the four kinds of information outlined above. Then move first to the visuals and then to the rest of the paper.

Features of Introductions

Introductions serve two purposes: creating readers' interest in the subject and providing them with enough information to understand the article. Generally, introductions accomplish this by leading readers from broad information (what is *known* about the topic) to more specific information (what is *not known*) to a focal point (what *question* the authors asked and answered). Thus, authors describe previous work that led to current understanding of the topic (the broad) and then situate their work (the specific) within the field.

Features of Methods

The Methods section tells the reader what experiments were done to answer the question stated in the Introduction. Methods are often difficult to read, especially for graduate students, because of technical language and a level of detail sufficient for another trained scientist to repeat the experiments. However, you can more fully understand the design of the experiments and evaluate their validity by reading the Methods section carefully.

Features of Results and Discussion

The Results section contains results—statements of what was found, and reference to the data shown in visuals (figures and tables). Normally, authors do not include information that would need to be referenced, such as comparison to others' results. Instead, that material is placed in the Discussion—placing the work in context of the broader field. The Discussion also functions to provide a clear answer to the question posed in the Introduction and to explain how the results support that conclusion.

Atypical Structure

Some articles you read will deviate from the conventional content of IMRD sections. For instance, Letters to *Nature* appear to begin with an abstract, followed by the body of the article. Upon reading, however, you will see that the “abstract” is a summary of the work filled with extensive introduction (for the purpose of catching the attention of a wide audience), and the next paragraph begins a description of the experiments.

Therefore, when you begin to read an article for the first time, skim the article to analyze the document as a whole. Are the sections labeled with headings that identify the structure? If not, note what the structure is. Decide which sections contain the material most essential to your understanding of the article. Then decide the order in which you will read the sections.

2. Distinguish main points.

Because articles contain so much information, it may be difficult to distinguish the *main points* of an article from the *subordinate points*. Fortunately, there are many indicators of the author's main points:

Document level

- Title
- Abstract
- Keywords
- visuals (especially figure and table titles)
- first sentence or the last 1-2 sentences of the Introduction

Paragraph level: words or phrases to look for

- *surprising*
- *unexpected*
- *in contrast with previous work*
- *has seldom been addressed*

- *we hypothesize that*
- *we propose*
- *we introduce*
- *we develop*
- *the data suggest*

3. Generate questions and be aware of your understanding

Reading is an active task. Before and during your reading, ask yourself these questions:

- Who are these authors? What journal is this? Might I question the credibility of the work?
- Have I taken the time to understand all the terminology?
- Have I gone back to read an article or review that would help me understand this work better?
- Am I spending too much time reading the less important parts of this article?
- Is there someone I can talk to about confusing parts of this article?

After reading, ask yourself these questions:

- What specific problem does this research address? Why is it important?
- Is the method used a good one? The best one?
- What are the specific findings? Am I able to summarize them in one or two sentences?
- Are the findings supported by persuasive evidence?
- Is there an alternative interpretation of the data that the author did not address?
- How are the findings unique/new/unusual or supportive of other work in the field?
- How do these results relate to the work I'm interested in? To other work I've read about?
- What are some of the specific applications of the ideas presented here? What are some further experiments that would answer remaining questions?

4. Draw inferences.

Not everything that you learn from an article is stated explicitly. As you read, rely on your prior knowledge and world experience, as well as the background provided in the article, to draw inferences from the material. Research has shown that readers who actively draw inferences are better able to understand and recall information.

As an example, in the box below is an excerpt from the Introduction of an article in the journal *Biochemistry* (Ballestar et al., 2000). The comments in italics are questions and inferences that might be drawn by a student reader.

Rett Syndrome is a childhood neurodevelopmental disorder and one of the most common causes of mental retardation in females *Comment: Hmmm...must be related to a gene on the X-chromosome*, with an incidence of 1 in 10000-15000. *Comment: How common is that? Not too likely to happen to me, but there must be several such children born in Houston every year.* Rett syndrome patients are characterized by a period of normal growth and development (6-18 months) followed by regression with loss of speech and purposeful hand use. *Comment: What happens? Something must be triggered or activated at late infancy.* Patients also develop seizures, autism, and ataxia. After initial

regression, the condition stabilizes and patients survive into adulthood. Studies of familial cases provided evidence that Rett is caused by X-linked dominant mutations in a gene subject to X-chromosome inactivation. Recently, a number of mutations in the gene encoding the methyl-CpG binding transcriptional repressor MeCP2 have been associated with Rett Syndrome. *Comment: MeCP2 mutations probably cause Rett Syndrome. This must be an important master-regulator to affect so many processes in the brain. I wonder what they know about it...*

5. Take notes as you read.

Effective readers take notes—it improves recall and comprehension. You may think you'll remember everything you read in researching class assignments, professional papers, proposals, or your thesis, but details will slip away. Develop a template for recording notes on articles you read, or adapt the template below for use. As you accumulate a large collection of articles, this template will help you distinguish articles and quickly locate the correct reference for your own writing. The time spent filling out the form will save you hours of rereading when you write a Background, Related Work, or a Literature Review section.

Template for Taking Notes on Research Articles: Easy access for later use

Whenever you read an article, pertinent book chapter, or research on the web, use the following format (or something similar) to make an electronic record of your notes for later easy access. Put quotation marks around any exact wording you write down so that you can avoid accidental plagiarism when you later cite the article.

Complete citation. Author(s), Date of publication, Title (book or article), Journal, Volume #, Issue #, pages:

If web access: url; date accessed

Key Words:

General subject:

Specific subject:

Hypothesis:

Methodology:

Result(s):

Summary of key points:

Context (how this article relates to other work in the field; how it ties in with key issues and findings by others, including yourself):

Significance (to the field; in relation to your own work):

Important Figures and/or Tables (brief description; page number):

Cited References to follow up on (cite those obviously related to your topic AND any papers frequently cited by others because those works may well prove to be essential as you develop your own work):

Other Comments:

References

Ballestar, E., Yusufzai, T.M., and Wolffe, A.P. (2000) Effects of Rett Syndrome Mutations of the Methyl-CpG Binding Domain of the Transcriptional Repressor MeCP2 on Selectivity for Association with Methylated DNA. *Biochemistry* 31, 7100-7106.

Burnett, R. (2001) *Technical Communication*. 5th ed. San Antonio: Harcourt College Publishers.

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Reading a Computer Science Research Paper

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(To appear in Inroads, the SIGCSE Bulletin, 2009)

Abstract

This tutorial article highlights some points that a graduate or senior undergraduate student should bear in mind when reading a computer science research paper. Specifically, the reading process is divided into three tasks: comprehension, evaluation and synthesis. The genre of paper review is then introduced as a vehicle for critical reading of research papers. Lastly, guidelines on how to be initiated into the trade of conference and/or journal paper review are given.

Designed to be used in a graduate course setting, this tutorial comes with a suggested marking scheme for grading paper reviews with a comprehension-evaluation-synthesis structure.

1 Comprehension

The first lesson to reading research papers is learning to understand what a paper says. A common pitfall for a beginner is to focus solely on the technicalities. Yes, technical contents are very important, but they are in no way the only focus of a careful reading. In general, you should ask yourself the following four questions when you are reading a research paper.

1. What is the research problem the paper attempts to address? What is the *motivation* of the research work? Is there a *crisis* in the research field that the paper attempts to resolve? Is the research work attempting to overcome the *weaknesses* of existing approaches? Is an existing *research paradigm* challenged? In short, what is the *niche* of the paper?
2. What are the claimed contributions of the paper? What is *new* in this paper? A new *question* is asked? A new *understanding* of the research problem? A new *methodology* for solving problems? A new *algorithm*? A new breed of software *tools* or

systems? A new *experimental method* ? A new *proof technique*? A new *formalism* or *notation*? A new *evidence* to substantiate or disprove a previously published claim? A new *research area*? In short, what is *innovative* about this paper?

3. How do the authors substantiate their claims? What is the *methodology* adopted to substantiate the claims? What is the *argument* of the paper? What are the major *theorems*? What *experiments* are conducted? *Data analyses*? *Simulations*? *Benchmarks*? *User studies*? *Case studies*? *Examples*? In short, what makes the claims *scientific* (as opposed to being mere opinions¹)?
4. What are the conclusions? What have we *learned* from the paper? Shall the *standard practice* of the field be changed as a result of the new findings? Is the result *generalizable*? Can the result be applied to *other areas* of the field? What are the *open problems*? In short, what are the *lessons* one can learn from the paper?

Every well-written research paper contains an *abstract*, which is a summary of the paper. The role of an abstract is to outline the answers to the above questions. Look therefore, first to the abstract for answers. The paper should be an elaboration of the abstract.

Another way of looking at paper reading is that every good paper tells a *story*. Consequently, when you read a paper, ask yourself, “What is the plot?” The four questions listed above make up an archetypical plot structure for every research paper.

2 Evaluation

An integral component of scholarship is to be critical of scientific claims. Ambitious claims are usually easy to make but difficult to substantiate. Solid scholarship involves careful validation of scientific claims. Reading research papers is therefore an exercise of critical thinking.

1. Is the research problem significant? Is the work scratching *minor itches*? Are the authors solving *artificial problems* (aka *straw man*)? Does the work enable *practical applications*, deepen *understanding*, or explore *new design space*?
2. Are the contributions significant? Is the paper *worth reading* ? Are the authors simply *repeating* the state of the art? Are there real *surprises*? Are the authors aware of the relation of their work to *existing literature*²? Is the paper addressing a well-known *open problem*?

¹Alternatively, what makes it a research paper rather than a *science fiction*?

²Be very sceptical of work that is so “*novel*” that it bears no relation to any existing work, builds upon no existing paradigm, and yet addresses a research problem so significant that it promises to transform the world. Such are the signs that the author might not be aware of existing literature on the topic. In such a case, the authors could very well be repeating works that have already been done decades ago

3. Are the claims valid? Have the authors been *cutting corners* (intentionally or unintentionally)? Has the right theorem been proven? Errors in proofs? Problematic experimental setup? Confounding factors? Unrealistic, artificial benchmarks? Comparing apples and oranges? Methodological misunderstanding? Do the numbers add up? Are generalizations valid? Are the claims modest enough³?

When you evaluate a research work, two caveats are worth noting:

- Consistently evaluating research works in a negative way gives a young researcher a false sense of being critical. Learn to be fair: attend to both the strengths and weaknesses of the work. If you are reading a classical paper that has been published for a while, make sure you are reading the paper in the right historical context: What seems to be obvious now might have been ground-breaking then.
- A young researcher may want to focus on point 3 (Are the claims valid?). Evaluating the significance of the research problem and the contributions of the paper usually requires a comprehensive understanding of the research field as a whole. Yet, do not let the above comment hinder you from disagreeing with the paper authors in matters of significance.

3 Synthesis

Creativity does not arise from the void. Interacting with the scholarly community through reading research papers is one of the most effective ways for generating novel research agendas. When you read a research paper, you should see it as an opportunity for you to come up with new research projects. The following is a list of questions you can ask to help in this direction. (Of course, this list is not supposed to be exhaustive.)

- What is the crux of the research problem?
- What are some alternative approaches to address the research problem?
- Is there an alternative way to substantiate the claim of the authors?
- What is a good argument against the case made by the authors?
- Can the research results be strengthened?
- Can the research results be applied to another context?
- What are the open problems raised by this work?
- *Bottom line:* If you were to do the research, how would you do differently?

³It is very tempting for an inexperienced researcher to make overly general conclusion from limited evidence. A high quality scientific claim is always *modest* — claiming only what can be concluded from the evidence, making explicit the limitation of the evidence, and carefully delimiting the scope of the claim.

4 Paper Review

A paper review is a short essay (5 pages, single-space) reporting what you have learned from reading a research paper. Writing reviews for the papers you have read is a great way to sharpen your paper reading skills. Such a review is typically structured in three sections — *summary*, *critique*, and *synthesis*.

1. Summary. Give a brief summary of the work *in your own words*. This section demonstrates your understanding of the paper, and as such it should answer the four questions outlined in Section 1. The summary section should be structured as follows: (1) motivation, (2) contribution, (3) methodology and/or argument, and (4) conclusion.

It is imperative that you use your own words to summarize the paper. Failing to adhere to this guideline not only constitutes plagiarism, but also demonstrates that you probably do not quite understand the work. You can be sure that you understand something only when you are capable of explaining it in your own words.

2. Critique. Pick two to three points⁴ you want to argue with the authors⁵. Use the questions outlined in Section 2 to help you come up with meaningful critiques.

Do not repeat the Limitations section of the paper. Doing so means that you *agree* with the authors! Pick points of *disagreement*, and launch an intellectual debate with the authors. Carefully articulate and substantiate your case. Do not just say, “I don’t like this point.” Instead, give technical reasons to substantiate your critiques.

Be specific in your choice of words. Avoid generic adjectives such as “bad”, “poor”, “lame”, “stupid”, etc, and their synonyms and antonyms. You can go a lot further by replacing such vague words with more specific ones: “inelegant”, “inefficient”, “memory-intensive”, “ill-defined”, etc.

3. Synthesis. Propose one to two ways in which the research work can be further developed. Do not repeat the *Future Work* section of the paper. Be original. Consult the list of questions in Section 3 if you run out of ideas.

I use this format when I ask students in my graduate classes to review a paper. Consult the Appendix for a sample outline, a marking scheme, and page length suggestions.

⁴This restriction on the number of critiques is intentional. Firstly, the restriction forces you to pinpoint the major weaknesses of the paper, rather than to spend efforts debating issues of peripheral importance. Secondly, such a restriction allows you to enjoy the mental room necessary for developing a substantial case against the authors.

⁵Notice that the Critique section presents only negative evaluations of the paper. Have we forgotten about being fair to a research work? No, positive evaluations are omitted for a good reason. Experience tells us that students tend to give positive evaluation in the following form: “I agree with the authors. They did this and that, and they did a good job.” The end result is usually a repetition of the authors’ claims. I find that focusing on critiques offers a more substantial learning experience to the students, forcing them to think rather than to parrot.

5 An Alternative Review Format

The format of paper review outlined in the previous section is the one I adopt for my graduate classes. It works for me, but it is definitely not the only way to structure a paper review. I outline here an alternative format I learned from a friend of mine.

1. *What is the purpose of the work?*
2. *How do the authors achieve this purpose? Why is this particular approach adopted?*
3. *Do you think the purpose has been achieved?*
4. *What insights have you gained from reading this work?*

Notice the parallel between this alternative structure and the summary-critique-synthesis structure in the previous section.

6 Reading Like a Pro

When a research paper is submitted to a conference or a journal, it will undergo a *peer review* process, in which the paper is subject to the intense scrutiny of peer researchers. The *referees* who review the submitted paper will read the paper in more or less the same way as we outlined in Sections 1 and 2, and then they will write up a *referee report* in a style similar to the paper review discussed in Section 4, except for the synthesis section. Based on the referee reports, the program chair of a conference or the editor of a journal will then make the decision of whether to accept the paper. It is therefore instructional to understand how a referee go about reviewing a paper, and learn to read research papers like a professional. A very good introduction to the subject can be found in an article by Smith [2]. The paper is slanted towards experimental computer science. For a perspective focusing on theoretical computer science, consult the article by Parberry [1]. After reading these papers, I highly recommend graduate students to find opportunities to practice professional paper reviewing. Your supervisor will likely be involved in the program committees of conferences, or asked to review papers for conferences. Approach your thesis supervisors, and volunteer to help out with paper reviews. By actually writing up a professional review report, and discussing your review with your supervisor, you will gain tremendous insight into the paper publishing process, as well as the implicit value system of the academic world. This kind of training is hard to acquire through other means.

References

- [1] Ian Parberry. A guide for new referees in theoretical computer science. *Information and Computation*, 112(1):96–116, July 1994.
- [2] Alan Jay Smith. The task of the referee. *IEEE Computer*, 23(4):65–71, April 1990.

A Sample Outline of a Paper Review

Review: *Title of Paper being Reviewed*

Author of this Review

Other information such as student ID

1 Summary (40% : 2.5 pages)

1.1 Motivation (8%)

1.2 Contribution (8%)

1.3 Methodology (16%)

1.4 Conclusion (8%)

2 Critique (30% : 1.5 pages)

2.1 Title of 1st Critique (15%)

2.2 Title of 2nd Critique (15%)

2.3 Optional: Title of 3rd Critique

If a 3rd critique is given, then each critique is worth 10%.

3 Synthesis (30% : 1 page)

3.1 Title of 1st Idea (30%)

3.2 Optional: Title of 2nd Idea

If a 2nd idea is presented, then each idea is worth 15%.

Researcher Bias in Software Engineering Experiments: a Qualitative Investigation

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Abstract—Researcher Bias (RB) occurs when researchers influence the results of an empirical study based on their expectations. RB might be due to the use of Questionable Research Practices (QRPs). In research fields like medicine, blinding techniques have been applied to counteract RB. We conducted an explorative qualitative survey to investigate RB in Software Engineering (SE) experiments, with respect to: (i) QRPs potentially leading to RB, (ii) causes behind RB, and (iii) possible actions to counteract RB including blinding techniques. Data collection was based on semi-structured interviews. We interviewed nine active experts in the empirical SE community. We then analyzed the transcripts of these interviews through thematic analysis. We found that some QRPs are acceptable in certain cases. Also, it appears that the presence of RB is perceived in SE and, to counteract RB, a number of solutions have been highlighted: some are intended for SE researchers and others for the boards of SE research outlets.

Index Terms—Survey, interview, researcher bias, blinding.

I. INTRODUCTION

In research, *bias* is defined as the combination of various design, data, analysis, and presentation factors tending to produce findings that should not be produced [1]. *Researcher Bias (RB)*, or *experimenter bias*, occurs when researchers, consciously or unconsciously, influence the results of an empirical study based on their expectations. In some cases, RB is due to the adoption of Questionable Research Practices (QRPs) to follow one's agenda and achieve specific expectations—e.g., adjusting an experimental sample until statistically significant results are found. Another form of bias is *publication bias*, which occurs when studies are published based on their results—usually positive results are more likely to be published than negative ones [2]. To counteract RB, according to established guidelines in Software Engineering (SE), researchers should disclaim their stance regarding an outcome. For example, Wohlin *et al.* [3] consider *experimenter expectancies* as a social threat to construct validity. Nevertheless, it has been shown that RB affects SE studies [4], [5].

In this paper, we report the opinions of a group of experts about themes related to RB in SE experiments. To this end, we conducted a qualitative explorative survey. The scope of

our research is both on human- and technology- oriented experiments [3]. We are concerned with: QRPs related to RB, causes behind RB, and possible actions to counteract it. Regarding the latter, we focus on two techniques—*blind data extraction* and *blind data analysis*. The former consists of hiding some information (e.g., treatment assignment) from the researchers who extract the data; whereas, the latter is the temporary and judicious removal of labels and alteration of values before someone analyzes the data [6]. Although extensively used in other research fields like medicine and physics [6], [7], SE researchers have used these techniques in few occasions [8], [9]. To collect data, we conducted semi-structured interviews. Nine experts in the field of empirical SE took part in these interviews. We then applied thematic analysis [10] to organize experts' opinions.

II. BACKGROUND

In this section, we survey the status of RB in SE, along with QRPs associated to it. Moreover, we describe countermeasures to RB including blinding techniques, which our survey explicitly focuses on.

A. Questionable Research Practices and Researcher Bias

Cases of QRPs, exploiting the gray area of what is considered acceptable, have been mounting in medicine, natural sciences, and psychology (e.g., [11], [12]). As for the SE research field, Jørgensen *et al.* [5] documented the presence of RB and publication bias in SE experiments. The authors conducted a quantitative questionnaire-based survey, with researchers from some SE sub-communities, comprising questions about QRPs potentially leading to RB and publication bias. Three out of seven questions were on QRPs related to RB, namely:

- 1) *Post-hoc hypotheses*—defined as reporting the results of one (or more) hypothesis tests where at least one of the hypotheses is formulated after looking at the data.
- 2) *Post-hoc outlier criteria*—defined as developing or changing the rules for excluding data (e.g., outlier removal) after looking at the impact of doing so on the results.

- 3) *Flexible reporting of measures and analysis*—defined as using several variants of a measure or several tests and then reporting only the measures and tests that give the strongest results.

The results suggest that: (i) 67% of the respondents had followed the post-hoc hypotheses practice; (ii) 55% had followed the post-hoc outlier criteria practice; and (iii) 69% had followed the flexible reporting of measures and analysis practices. Jørgensen *et al.* [5] also built a model—150 randomly-sampled SE experiments fed the model—to estimate the proportion of correct results at different levels of RB and publication bias. The model suggests that both RB and publication bias affect SE experiments since 52% of the statistically significant tests do not match a situation with no or low RB and publication bias. Shepperd *et al.* [4] in their meta-analysis of defect prediction techniques came to a conclusion similar to that by Jørgensen *et al.* [5]. The authors pointed out the presence of RB in the studies included in the meta-analysis as the factor with the largest effect was the research group publishing the paper, while the effect of the prediction technique was small.

B. Countermeasures to Researchers Bias

Potential solutions to counteract RB have been proposed (e.g., [13], [14]). We can group them into: (i) *rival theories*; (ii) *transparency*; and (iii) *blinding*. The first category consists of considering alternative or competing hypotheses with respect to the ones being tested in the study. The researcher should then devise experiments that can explicitly distinguish competing hypotheses and, if possible, develop experiments that can distinguish between alternative theories. The researcher should collaborate with a *team of rivals*—i.e., other researchers that, while being skeptical about the hypotheses, collaborate towards developing alternative explanations.

Several approaches fall under the umbrella of the transparency category. The prime example is *open science*, i.e., the practice of sharing research data, computer code, and lab packages for public scrutiny so attempting to reproduce results. In fields like medicine or psychology, transparency is also achieved through *pre-registration* (or *registered report*). It consists of submitting a paper presenting the study rationale and planning for peer review before its conduction. Once the paper is accepted, the researchers can conduct the study and submit a paper with the obtained results for a second round of revision. The paper cannot be rejected due to the study results (e.g., negative results) while it can be for other reasons (e.g., deviations from the pre-registered analysis procedure) [15].

Finally, blinding (or *masking*) means concealing research design elements (e.g., treatment assignment or research hypotheses) from individuals involved in an empirical study (e.g., participants, data collectors, or data analysts) [16], [17]. The use of blinding techniques has been encouraged fields like medicine and physics [6], [7]. As for SE, Shepperd *et al.* [4] have fostered researchers to use blinding techniques in their studies; however, few researchers have applied blinding in SE studies so far, namely: Fucci *et al.* [8], who used blind data extraction and analysis in a human-oriented experiment; and

Sigweni and Shepperd [9], who applied blind data analysis in a technology-oriented experiment.

To explain how blind data extraction and analysis work, let us take as an example the experiment by Fucci *et al.* [8]. The study goal was to investigate the claimed effects of Test-Driven Development (TDD), such as the increase in developers' productivity. The experiment compared a *treatment group*—i.e., developers who applied TDD to implement some programs—to a *control group*—i.e., developers who implemented the same programs as the other group but by applying Test-Last Development (TLD). After the experiment took place, the raw dataset (i.e., the programs the developers implemented) was given to a researcher that played the role of data extractor. Given the raw dataset, this researcher extracted the values of the metrics (e.g., the PROD metric quantified developers' productivity) so obtaining the dataset. The extraction of the metrics was done blindly because the data extractor was not aware of the experimental goal, hypotheses, treatment assignment, and design. The dataset was then given to the data analysts who performed the blind data analysis. They were not aware of the experimental goal and they worked on a sanitized dataset—i.e., the values of the independent variables were temporarily replaced (e.g., the TDD and TLD groups became the A and B groups, respectively) and the dependent variables were temporarily anonymized (e.g., PROD was renamed as DV1). To correctly analyze the data, the analysts were provided with a minimal description of the dependent and independent variables (e.g., DV1 assumed values in [0, 1]) as well as the experimental design in which some information was adequately hidden (e.g., the experimental groups were referred as A and B). Once the analysis was complete, the hidden information was revealed.

III. STUDY DESIGN AND LIMITATIONS

A. Goal

Unlike quantitative research that seeks to provide quantifiable responses to some research questions, qualitative research (like ours) is concerned with understanding subjects' viewpoints about a given phenomenon and discovering the causes behind that phenomenon as noticed by the subjects [3]. Therefore, the goal of our study is to elicit the opinions of a group of experts about RB in SE experiments, including: (i) QRPs potentially leading to RB; (ii) causes behind RB; and (iii) potential actions to counteract RB with a focus on, but not limited to, blind data extraction and analysis. That is to say that, while the studies by Shepperd *et al.* [4] and Jørgensen *et al.* [5] show the presence of RB in SE studies by leveraging quantifiable responses, we are more interested in investigating the phenomenon of RB based on researchers' viewpoints. Our study can be thus considered complementary to those above-mentioned [4], [5].

B. Protocol

We planned a series of interviews with experts from the empirical SE community to investigate on RB. Despite interviewees are time-consuming, we opted for this data collec-

TABLE I: Characterization of the interviewees involved in this study.

ID	Institution region	Academic position	Main research interest	Experience as experimenters	Last published experiment
R1	Southeastern Europe	Assistant professor	Defect prediction	5-10 (years)	< 6 months
R2	Northern Europe	PhD student	Human and social aspects of SE	1-5 (years)	< 18 months
R3	Northern Europe	Full professor	Mining software repositories	11-20 (years)	< 6 months
R4	Northern America	Associate professor	Agile software development	11-20 (years)	< 6 months
R5	Central Europe	Assistant professor	Software maintenance and evolution	5-10 (years)	< 3 years
R6	Southern Europe	Associate professor	Software economics and metrics	11-20 (years)	< 1 year
R7	Southern Europe	Assistant professor	Project and process management	11-20 (years)	< 1 year
R8	Southern Europe	Full professor	Collaborative software development	> 20 (years)	< 18 months
R9	Southern Europe	Full professor	Software economics and metrics	11-20 (years)	< 6 months

tion means, rather than questionnaires, because: (i) it allows achieving higher response rates; (ii) it decreases the number of “don’t know” and “no answers”; and (iii) the interviewer can ask for clarifications if needed [3]. Also, such a method fits the explorative intention of our study.

We recruited researchers in our network based on their experience in SE experimentation (both human- and technology-oriented). Nine researchers were available for an interview either face-to-face or by phone. Each interview involved the same interviewer (*i.e.*, DF) together with one interviewee at a time. We obtained consent from the interviewee to be audio-recorded and we informed each of them that the gathered data would be treated confidentially. Each interview lasted between 50 and 75 minutes. We used semi-structured interviews [3]. That is, the questions listed in the interview script were not necessarily asked in order because, depending on how the conversation evolved, some questions were handled before than others. Semi-structured interviews enable improvisation and exploration of the investigated phenomenon. The interview script serves to guide the discussion and make sure that relevant topics are covered [3].

The interview script¹ consisted of eight parts. The objective of the first part (*i.e.*, *Warm Up*) was to gather demographic information on the interviewees (*e.g.*, where the researcher was employed or her research interests). This information allowed us to characterize the study context. As for the second part (*i.e.*, *Experiments*), the interviewer asked to guide him through the usual experimental process of the interviewee. The goal was to break the ice between interviewer and researcher by gathering information on how researchers design an experiment and the division of work in case a team of researchers is involved. We were also interested in their perception of threats to validity that can arise given their design choices. In the third part (*i.e.*, *QRP*), we gathered the interviewees’ viewpoints on some QRPs recently reported in the survey by Jørgensen *et al.* [5]. We considered those QRPs potentially leading to RB, namely: post-hoc hypotheses, post-hoc outlier criteria, and flexible reporting of measures and analyses. We did not consider QRPs related to publication bias because our paper does not focus on this kind of bias. In the fourth part (*i.e.*, *RB*), we focused on how the interviewees perceived RB in SE experiments, the causes behind it, and their suggestions to avoid/mitigate it. With the fifth (*i.e.*, *Blind Data Extraction*) and sixth (*i.e.*, *Blind Data Analysis*) parts, we centered the discussion on blind data extraction and analysis, respectively. We gathered opinions about the aforementioned techniques

to cope with RB. As for the seventh part (*i.e.*, *Blind Data Extraction and Analysis*), we focused on the interviewees’ thoughts on the use of blind data extraction and analysis together, as well as how to foster the use of these techniques. We ended each interview (*i.e.*, *Wrap Up*) by asking whether the interviewee would use blind data extraction and analysis in her future experiments.

C. Participants

All the interviewees had, at the time of our study, published at least one experiment in one of the SE higher quality venues (*i.e.*, ICSE, EMSE, IEEE TSE, and ACM TOSEM). In Table I, we report some interviewees’ information gathered in the *Warm Up* part of the study. We guarantee the anonymity of the interviewees by referring to each of them through an ID (from R1 to R9). As Table I shows, the participants were quite heterogeneous in terms of location of their institution, academic position, main research interest, years of experience as experimenter, and date of last published experiment.

D. Data Analysis

After transcribing the recordings of the interviews, we (*i.e.*, SR, MTB, and GS) analyzed the transcripts using a thematic analysis approach called template analysis, which is known to be flexible and fast [10]. Template analysis allows developing a list of codes, each of which identifies a theme within the transcripts. The codes are arranged in a *template*—it usually is a hierarchical structure of codes—showing the relationships among themes, as defined by the investigators. In template analysis, the investigators start analyzing the transcripts by using an initial template. That is, they attach pre-defined codes, arranged in a template, to delimit portions of text related to themes. As King [10] suggests, the best starting point for developing an initial template is the interview script. Accordingly, we developed our initial hierarchical template (see the non-bold text in Figure 1) from the interview script. As customary in template analysis, we revised the initial template during the analysis [10]. In particular, we renamed the second-level code *Presence of Researcher Bias* as *Presence of Researcher Bias and Clues* because we found portions of text about clues suggesting the presence of RB. We concluded the analysis when any portion of text relevant to the goal of our study was coded and we agreed on the obtained template. To ease the thematic analysis, we used the *ATLAS.ti* tool.

E. Limitations

When interpreting the findings from qualitative investigations, some limitations have to be taken into account:

¹<https://doi.org/10.6084/m9.figshare.12356213.v1>

Experiments
Researcher Roles
Threats to Validity
Questionable Research Practices
Post-hoc Hypotheses
Post-Hoc Outlier Criteria
Flexible Reporting of Measures and Analyses
Researcher Bias
Presence of Researcher Bias And Clues
Causes of Researcher Bias
Coping with Researcher Bias
Blind Data Extraction
Usefulness of Blind Data Extraction
Drawbacks of Blind Data Extraction
Blind Data Analysis
Usefulness of Blind Data Analysis
Drawbacks of Blind Data Analysis
Blind Data Extraction and Analysis
Effectiveness of Blind Data Extraction and Analysis
Fostering Blind Data Extraction and Analysis

Fig. 1: Initial and final templates (in bold, text added to the initial template to obtain the final one).

- The interviewees may not answer truthfully because, for example, they are scarcely motivated or afraid of being judged. To mitigate this threat, the participation in the study was voluntary—volunteers are generally more motivated [3]—and we informed the interviewees about data confidentiality.
- The number of the interviews might threaten the validity of results. However, Guest *et al.* [18] observed that a sample of six interviews may be sufficient to allow development of meaningful themes and useful interpretations. Given the results observed after the analysis of the nine interviews, we believe to have hit a point of diminishing return [18] for which increasing the number of interviews will unlikely generate more evidence. Moreover, our plan includes (quantitative) surveys, based on questionnaires, with researchers from different SE sub-communities (*e.g.*, ICSE or ESEM) to understand how much they agree with the interviewees' statements (*i.e.*, we are going to apply *methodological triangulation* [19]) and whether or not there are differences among different SE sub-communities.
- Our findings might not generalize to researches sampled from a different population. As previously mentioned, we are going to investigate this point in our long-term plan with quantitative surveys.
- The investigator might unconsciously influence the results based on its expectations. We mitigated such a threat by involving more people in conducting and analyzing the interviews. In particular, DF was the interviewer while SR, MTB, and GS performed the data analysis (*i.e.*, we applied *investigation triangulation* [19]).

IV. FINDINGS

We present the findings emerging from the interviews based on the main themes identified by the first-level codes (*e.g.*, *Questionable Research Practices*) of the final template shown in Figure 1. To bring credibility to our findings, we present them together with some excerpts from the transcripts.

A. Experiments

As shown in Figure 1, two sub-themes were defined within this main theme: the roles of researchers in SE experiments and how they cope with threats to validity in their experiments.

Researcher Roles. It emerged that, when conducting an experiment, there is a division of roles among the researchers. Each researcher covers one or more roles (*e.g.*, one researcher is involved in the planning of the experiment and in its execution, another one extracts the metrics from the raw data and so on). However, it seems that only one researcher takes care of data analysis (*i.e.*, one researcher plays the data analyst role). An excerpt from the interview with R6 follows:

“We [our research group] outlined the experiment design. The researchers from [other country] translated the experiment material into [other language] and carried out the experiment in [other country]. We then received the gathered data, some Excel files, and one of us executed the analysis.”

Threats to Validity. When we asked the interviewees to elaborate on threats to validity, they provided a number of examples, but none mentioned RB.

B. Questionable Research Practices

This theme includes three sub-themes (see Figure 1): the participants' perceptions of post-hoc hypotheses, post-hoc outlier criteria, and flexible reporting of measures and analyses.

Post-hoc Hypotheses. According to the interviewees, post-hoc hypotheses should not lead to RB as long as: (*i*) the researchers clearly report that such hypotheses are formulated in retrospect; or (*ii*) it is possible to ground such hypotheses on prior work (thus, there is no need to make clear that such hypotheses are post-hoc). Regarding (*i*), R5 said:

“In this case, first of all I am not sure we can talk about formulating hypotheses because you are already looking at the data of an experiment [...] In general, I don't think there is anything wrong with that if, and I think it is completely sound, if you explicitly say that it is an unexpected result when reporting this result. This is different from saying “we wanted to investigate this and we found that it is supported by the data.””

As for the point (*ii*), R3 said:

“Of course, there's the fact that, the hypothesis should be grounded on prior work. If you can ground something to solid prior work, then it doesn't really matter whether it was sort of after the fact.”

Also, it seems post-hoc hypotheses could be a means to get new insight into the studied phenomenon, which researchers had not thought about when the study was planned. R4 said:

“It [a post-hoc hypothesis] emerged from the data and inevitably happens. When you look at the data, you may have, you may think of new insights that you haven't thought about because there is information that was not anticipated. [...] Sometimes there are research methodologies that don't even assume any questions, they are completely totally exploratory. So let's suppose that you have a set of questions, and you wanna answer them first. After you answer those questions, then you see some other patterns in your data and then, in the next iteration, you formulate a set of other questions that maybe you can answer based on the same data. This is completely okay but it's not the same as fishing.”

Post-hoc Outlier Criteria. The interviewees seem to believe that this practice should be avoided because it potentially leads to RB, though not necessarily. R5 told us:

“Looking at the results and then removing outliers could sometimes be sensible, but I think the bias would be too strong.”

In case researchers apply the post-hoc outlier criteria practice, the interviewees agreed that they should declare the use of this practice in the paper by providing, for example, the following information: (*i*) the results before and after removing outliers; (*ii*) the reasons behind the outlier removal; and (*iii*) an interpretation of the results (*e.g.*, why, after the outlier removal, a null hypothesis passes from non-rejected to rejected). R4 said:

As long as you declare the results and you present maybe both of them [before and after the outlier removal], depending on how other factors influence your interpretation. Maybe there are other things that you discovered during your data analysis that justifies that decision. But as long as you declare them, I mean that is one of the purposes of the peer review, the reviewers can also decide which one is, whether that decision was sensible or not.

Flexible Reporting of Measures and Analysis. Based on interviewees' experience, when researchers can choose among equivalent statistical hypothesis tests (e.g., t-test or F-test), the results (i.e., p-values) are not so different. R8 told us:

It's true that there are a lot of statistical hypothesis tests and there are a lot of variants as well, when using statistical packages we are spoilt for choice, but in my experience they don't vary so much.

Furthermore, according to R3, if a statistical hypothesis test revealed a significant difference that an equivalent test did that difference would be probably negligible. In other words, the effect size would show the true impact of that difference, so having or not a significant difference would not matter:

It [using a statistical hypothesis test or an equivalent one] doesn't really impact the results very much. It's a very very tiny difference, at least what I have seen. It doesn't change from .04 to .0004, or something. I mean you might, if you again use this magical threshold of .05, then it might matter. But if you report the effect sizes, then it really doesn't. The effect sizes sort of reveal the true impact.

As for the practice of using several variants of a measure and then reporting only the variants that give the strongest results, it is perceived as a bad practice. The researchers should discuss any variant of that measure in the paper. R4 said:

Yeah I think that is a no, in general. If you've done [flexible reporting of measures], there needs to be a discussion of how your attempt to triangulate the results with different measures failed. That should be part of the discussion and it's part of the validity threats that you have.

C. Researcher Bias

This theme has three sub-themes (see Figure 1): the presence of RB in experiments and clues suggesting such a presence; causes of RB; and strategies to cope with RB.

Presence of Researcher Bias and Clues. From the interviews, it emerged that RB affects the SE community. Although the interviewees did not have proofs about the presence of RB in SE, they pointed out four clues suggesting its presence: (i) RB affects any community (e.g., medicine or psychology); (ii) when reviewing papers, it is not rare to suspect authors biasing the results; (iii) whoever could unconsciously bias the results based on her expectations; and (iv) there are sometimes inconsistent results among studies investigating the same constructs. On the points (i) and (ii), R4 stated:

I think it [RB] must be happening because it's probably happening in every community. But I'm not sure. I mean I think, in terms of my review work, when things are suspicious, it's usually obvious and it's usually not just from one reviewer picking on them, rather, multiple reviewers do and it's only because, the researchers actually let it be understood in the paper.

As for the point (iii), R3's thought follows:

I guess everyone that does experiments is somehow biased because you know that negative results cannot be published and it probably, sort of unconsciously, alters your actions.

On the last point, R8 said:

That is, if I see that a given result isn't confirmed [by another study], then it is a clue of researcher bias.

Causes of Researcher Bias. Four causes of RB emerged from the interviews. First, interviewees believed that *negative-*

results papers are usually rejected. This would lead researchers to bias their results (e.g., transforming non-significant results into statistically significant ones). R2 said:

I think the main reason to that is there is no acceptance for reporting the negative results. You are a researcher and your responsibility is just to explore the phenomenon, whether it is in favor of your hypothesis or it's against your hypothesis you should report it, but I've personally felt like there is no in general acceptance for that.

Second, the *pressure of publishing papers* can lead researchers to (unconsciously or consciously) bias the results. R5 said:

Especially young researchers, for example Ph.D. students, that carry out and are therefore responsible for the experiment, may tend to have high expectations on what they have developed or towards the hypothesis being verified, to the point that, even unconsciously, they may tend to guide the experiment towards a certain expected result. I am quite confident to say that, although not always, this occurs especially with novice experimenters that are more eager for publications and may therefore be led to experimenter bias.

Third, it seems that *revision processes of SE conferences/journals are focusing too much on the empirical assessment*, rather than on the contributions of the ideas to the body of knowledge. Thus, researchers would be led to bias their studies by making the results more publishable. R5 told us:

I think that the main problem of several review processes is that they are highly based on the empirical aspect and much less on the novelty of the ideas. So in spite of you propose an interesting and novel idea that several other researchers can build on, if the experimental results are not strong enough you are likely to receive a comment like "okay nice idea but ...". On the other hand, if a study is empirically perfect, from the point of view of the design and results, but has very limited novelty, it's difficult that it will be rejected.

Fourth, the *immaturity of the SE field and its researchers.* That is, some researchers believe not to bias the results of their experiments when they actually do. In this respect, R9 said:

Sometimes, in good faith, one may think that this does not represent an actual threat to the experiment.

Coping with Researcher Bias. The interviewees suggested seven strategies to cope with RB. First, the use of *pre-registration* in SE conferences/journals (see Section II-B). This should prevent negative-results papers from being rejected. Also, pre-registration increases both credibility of study results and study replicability [15]. Therefore, researchers should be less prone to bias their results. On this point, R5 said:

Personally, I have an idea. It doesn't relate to the experimental design, rather to a discipline. It consists of having dedicated tracks of a conference or sections of a journal where authors don't submit the results of an experiment, but the experiment they plan to carry out.

Second, fostering *open data policies* in SE conferences/journals. This means not only making the gathered data publicly available, but also the analysis scripts of the study. Such open data policies should allow the reviewers (and any other researcher) to repeat the data analysis of that study so attributing credibility to study outcomes and increasing the replicability of the study. Therefore, researchers should be discouraged from biasing their studies. R1's thought follows:

Another thing could be publishing all the analyses together with the data. But then that implies during the review process that, as a reviewer, I have to go and take a look at the analysis as well.

Third, *duplicate data analysis.* That is, two researchers analyze the same data with their own scripts without interacting with one another. Then they exchange the scripts and data to cross-check them. Finally, the results of the data analysis are com-

pared. R5 mentioned this kind of data analysis, (she/he was using at the time of the interview), which should mitigate the unconscious bias of researchers involved in the data analysis.

The only thing I do, from about three years, is that data is always analyzed independently by two researchers. Next, they exchange the scripts and cross-check them. They exchange the data and cross-check them as well. Finally, they compare their conclusions.

Fourth, *means for increasing the awareness* of RB in SE. For example, panels on RB in SE, an ethical code for SE warning researchers against this kind of bias, or papers on RB in SE. Therefore, by increasing the awareness of RB, researchers should be warned against this kind of bias. R6 told:

Fostering panels and discussions on this [researcher bias], conducting surveys and studies, like the one you are conducting, to understand the status of the community.

Fifth, *guidelines for reviewers* in SE conferences/journals. These guidelines should instruct the reviewers not to judge papers on the basis of the study results (*i.e.*, positive/negative results). As a consequence, researchers would bias the study results less because having a paper reporting positive/negative results would be equally valid. On this matter, R4 said:

Perhaps review guidelines may also help, in the sense that you instruct the reviewers, specifically not to bias their reviews only if the results are favorable to the hypothesis of the researchers.

Sixth, *ad-hoc research tracks* in SE conferences (or ad-hoc issues in SE journals). For example, specific tracks for papers reporting negative results or specific tracks for studies having a not as strong empirical assessment. Such kind of tracks should lead researchers not to bias their results to have more publishable results. On this point, R7 said:

Having various publication-levels where non-rigorous studies carried out by research groups or companies can be published in prestigious journals.

Seventh, *replicated experiments* because the more the results of a study are confirmed by replications, the lower the likelihood of RB is. In this respect, R8 told us:

I trust when the results are confirmed by more studies carried out by researchers that are not co-authors. I don't think only one paper is enough. I don't confide in the results of only one paper. Of course, this doesn't mean that single studies are conducted incorrectly or are error-prone, it simply impacts on generalizability.

Besides the strategies, mentioned by the interviewees, to cope with researches bias, we asked their thoughts on two further strategies, *i.e.*, blind data extraction and blind data analysis, used alone or together. In the following subsections, we report the findings concerning the sub-themes for blind data extraction, blind data analysis, and both these strategies.

1) *Blind Data Extraction*: Two sub-themes were defined for this theme (see Figure 1): usefulness and drawbacks of blind data extraction in SE experiments.

Usefulness of Blind Data Extraction in SE. It emerged from the interviews that blind data extraction could be a useful technique to mitigate RB because, even when extracting the metrics, a researcher could favor a given treatment based on her expectations. In other words, if the data extractor (*i.e.*, the person who is responsible of extracting the metrics from the raw dataset) is aware of research design elements (*e.g.*, treatment assignment), then the likelihood of influencing the

results towards a given treatment is higher. This is why having blinded extractors would lessen the likelihood of influencing the results. In this respect, R3 said:

Yeah, I think it [blind data extraction] sounds like a good idea. I believe that they [the researchers] may apply bad practices of statistical analysis but actually I believe more that one does it, consciously or unconsciously, while they code the data, or do it even before running the experiments because the researcher knows what treatment is and what the control is. I think that's a good idea that labels are removed and someone else transforms the data.

Drawbacks of Blind Data Extraction. As for the drawbacks of blind data extraction, the interviewees pointed out that the implementation of blind data extraction requires at least two people: an individual (*i.e.*, the study executor) responsible of executing the experiment and another individual (*i.e.*, the data extractor) with the necessary skills to extract the metrics from the raw dataset. The latter has to be blinded to research design elements. This seems to be less feasible when both study executor and data extractor belong to the same research group—guessing or finding out about hidden information (*e.g.*, research hypotheses) would be more likely when both executor and extractor belong to the same research group. Therefore, to implement blind data extraction, it is preferable to have: (i) a research collaboration between two research groups where the experimenter and the extractor are not part of the same group, or (ii) an external expert that takes care of the metric extraction. To this respect, R8 stated:

I think it [blind data extraction]'s complicated. In many cases it's you and your PhD student, do you really think that your student isn't aware of who did certain things? [...] Maybe it can work in a joint experiment where you have a large group of people collaborating from various independent research groups. On the other hand, within the same group it is applicable in theory because you have several researchers involved, however it becomes an "open secret" as everyone is aware of what is going on. How much would it work within the same group?

Note that R5 had already used blind data extraction. She involved some experts to extract metrics from a raw dataset:

Well now that you have mentioned it [blind data extraction], we actually have done it on two papers in the past that I had forgotten about. What we did was to gather the artifacts produced by the participants and then give all to external people who evaluated the artifacts. [...] Yes, I think this is surely useful.

2) *Blind Data Analysis*: Two sub-themes were defined for this theme (see Figure 1): usefulness and drawbacks of blind data analysis in SE experiments.

Usefulness of Blind Data Analysis. Blind data analysis seems a useful technique to mitigate RB. A blinded analyst (*i.e.*, an analyst unaware of research design elements) would perform the data analysis more objectively than an analyst aware of research design elements. In this respect, R7 said:

It can be a means for a more objective analysis because it's human to be inclined to one's proposals and expectations. This can be thus an involuntary contribution, either positive or negative, that a researcher provides.

Drawbacks of Blind Data Analysis. The drawback of blind data analysis is that at least two researchers are needed—the former one conducts the study and sanitized the dataset, while the latter one performs the data analysis on the sanitized dataset. Moreover, it is preferable that the researchers do not belong to the same research groups. For example, R8 said:

It's similar to blind data extraction. That is, if you are conducting a joint experiment, you can apply blind data analysis.

3) *Blind Data Extraction and Analysis*: We defined three sub-themes for this theme: effectiveness of blind data analysis and extraction in coping with RB, strategies to foster the adoption of blind data analysis and extraction in SE experiments, and intention to use blind data analysis and extraction.

Effectiveness of Blind Data Extraction and Analysis.

RB could arise even if blind data extraction and analysis are applied together. That is, using both blind data analysis and extraction is considered a way to mitigate RB. In fact, RB could arise not only during the metric extraction and analysis phases but also during the execution of the experiment itself. In this respect, we report R3's answer when we asked if the combination of blind data extraction and blind data analysis was enough to cope with RB:

Most likely not. Like I said previously, the step before where you set up and where you run the experiment also introduces some [bias].

Fostering Blind Data Extraction and Analysis. The interviewees suggested a number of strategies to ease the adoption of blind data extraction and analysis in SE. The first strategy is a *policy* for conferences/journals similar to the double-blind peer-review one. That is, this policy would consist of requiring that any submitted experiment to that conference/journal had to use blind data extraction and analysis. However, this strategy is not always feasible, as the same interviewees observed, due to the following reasons: (i) the reviewers cannot make sure the authors of a paper have really used blind data extraction and analysis; (ii) researchers, who are not involved in research collaborations, would be harmed by this policy; and (iii) empirical evidence on the effectiveness of blind data extraction and analysis in SE is necessary to foster conferences/journals to adopt this policy. Regarding point (ii), R8 said:

In most cases, you have a [research] group that works independently... it does not involve several units, or you have a group made up of Ph.D. student and supervisor. In this case, how do you distinguish the roles and introduce any blinding in the process?

As for the last point, R4 said:

The conference committees won't do it [that policy] without any evidence that it's gonna be effective, just because it sounds like a good idea. Then, if there is enough evidence that it's a good idea, then maybe some conferences will start using it [that policy].

The second strategy to foster the use of blind data extraction and analysis is a *third-party service provider* that takes care of metric extraction and data analysis blindly. For example, the researchers conduct the experiment and, when needed, sanitize the raw dataset (e.g., it removes any label to the treatments). Then they submit the raw dataset to this service provider, which extracts the metrics and then analyzes the data. After analyzing the data, the service provider sends the results to the researchers. In this respect, R5 said:

An example could be an online service for data analysis where each participant, at the end of the [experimental] task, uploads its data on that platform and then someone else performs the data analysis. So who carries out the experiment does not interact with or manipulate the data, rather only acknowledges the results of the analysis. Clearly, this is costly and not easy to be realized.

This strategy also has its drawbacks. As pointed out by R5,

it is not easy to realize such a system. Also, the researchers should trust the service provider as well as the people that perform blindly the data extraction and analysis. Furthermore, it would most likely introduce extra costs. The third strategy consists of a *guideline* for applying blind data extraction and analysis in SE. R6 told us:

Someone should try to give guidelines on how to put them [blind data extraction and analysis] in practice.

Finally, *empirical evidence* on the effectiveness of blind data extraction and analysis in SE would foster the adoption of these blind techniques. On this matter, R4 said:

It would be nice if there could be some pilots or meta-studies that demonstrate how blind analysis and extraction change the results in either way, in favor or against the researcher's hypothesis.

Intention to Use Blind Data Extraction and Analysis.

The interviewees stated they would take into account blind data extraction and analysis for their experiments. R8 stated:

If I have to participate in a large joint experiment between several research groups, I can take this into account when assigning the roles, why not! Instead of doing everything myself.

V. DISCUSSION AND CONCLUSION

According to the interviewees, post-hoc hypotheses are not questionable as long as the researchers explicitly mention their use or it is possible to ground such hypotheses on prior work. Furthermore, this practice could be used to gain new insights into the investigated phenomenon. Similarly, the post-hoc outlier removal practice is not always questionable. In particular, it is considered acceptable when the researchers provide the results (after and before the outlier removal), justify the outlier removal, and discuss the causes behind possible differences. This is in contrast with the guidelines for evaluating SE experiments by Kitchenham *et al.* [20] for which "*the analysis protocol needs to address how drops out were handled*". According to the authors, a clear outlier dropout analysis is particularly relevant for researchers interested in integrating the results of similar experiments (e.g., meta-analysis). In other words, from SE researchers' perspective, some QRPs are acceptable in certain cases, as recognized in previous studies (e.g., [12]). The question that arises is to what extent QRPs relates to the presence of RB in SE experiments.

Based on our findings and those by Jorgensen *et al.* [5] and Shepperd *et al.* [4], it seems that RB affects SE experiments. Thus, we need to find solutions to mitigate RB as much as possible. Our results represent an initial exploratory step to establish guidelines to mitigate RB in SE experiments based on solutions for SE researches and editorial/program boards.

Solutions for Researchers. Researchers can take into account blinding techniques to extract and analyze the data of their experiments. The importance of applying these techniques is central when performing meta-analyses [20]. The researchers we interviewed were favorable to use them (or at least to take them into account) in their future experiments.

Although they acknowledged the usefulness of blind data extraction and analysis, such techniques alone do not solve the problem of RB but they are means to mitigate it. Our

findings suggested that blind data extraction and analysis are considered more effective in concealing information when the key roles (e.g., study executor and data extractor) are covered by people that do not belong to the same research group. Therefore, we encourage researchers to (i) involve external experts for blind data extraction and analysis or (ii) collaborate with other research groups to have external researchers taking care of data extraction and analysis. However, it has emerged that involving external experts or collaborating with other research groups is not always possible. Nevertheless, it is still possible to apply blind data extraction and analysis within the same research group. For example, a simple form of blind data analysis can be achieved by relabelling the treatment groups in the dataset with non-identifying terms to hide the actual treatments from the data analyst. We recognize that in this case the analyst could guess the hidden information, but such a solution is surely better than having no blinding at all. To mitigate RB, the researcher could also consider using duplicate data analysis—i.e., asking two or more people to analyze the data independently. This technique could be easily extended to data extraction. Duplicate data extraction and analysis could be applied as alternatives or in conjunction to blind data extraction and analysis. Other two solutions to counteract RB, on the researcher side, are: (i) replicated experiments and (ii) means for improving the awareness of RB. Regarding the former, the underlying assumption of the interviewees is: the more the experimental results are confirmed, the lower the likelihood of RB is. As for the latter solution, it is important to share knowledge on RB as well as strategies to deal with it—this paper represents a first step towards this direction.

Solutions for Editorial/Program Boards. The interviewees suggested fostering open data policies to mitigate RB since the more the studies are reproducible (e.g., because datasets and analysis scripts are publicly available), the less the likelihood of biasing the results is. In this respect, some conferences, such as ESEM 2018, have explicitly promoted open data policies. According to the interviewees, RB could be due to the behavior of some reviewers, namely (i) their tendency to reject negative-results papers (i.e., publication bias) or (ii) their tendency to focus too much on empirical assessment at the expense of contributions to the body of knowledge. Accordingly, reviewers' behavior can lead researchers to bias their results to make their papers more publishable. Therefore, acting on reviewers' behavior would possibly mitigate RB. The interviewees suggested ad-hoc tracks/issues for papers reporting negative results and studies having a weak empirical assessment but with a significant contribution to the body of knowledge. For example, SANER 2018 has had a track where authors could submit negative-results papers, while the short paper track of EASE 2020 is fostering the submissions of research where a weak design could invalidate interesting findings. Tracks/issues for pre-registration papers is another solution to counteract the tendency to reject negative-results papers—e.g., MSR 2020 is going to accept submissions of pre-registration papers. Guidelines for reviewers can help mitigating publication bias as well. For example, these guidelines

should instruct reviewers not to judge papers based on study results (e.g., positive/negative results). Accordingly, editorial board should enforce reviews to comply with the guidelines. Finally, conferences should consider having panels on RB in their programs to increase awareness of SE researchers about this problem and share solutions on how to limit it.

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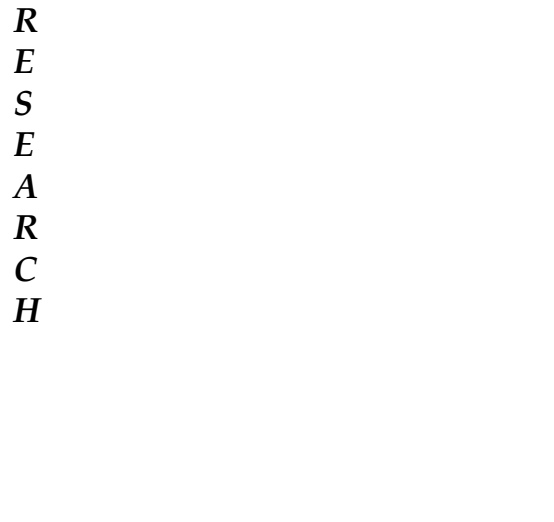
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RESEARCH

Research can be defined as the search for knowledge, or as any systematic investigation, with an open mind, to establish novel facts, solve new or existing problems, prove new ideas, or develop new theories.

Think of the word “research” as an acronym.



The Traditional Scientific Method:

The traditional scientific method consists of the following activities:

*Observation of selected parts of nature -----Explanation and Critical analysis of the findings-----Formulation of hypothesis-----Verification through experimentation-----
Fact/Knowledge generated.*

Purposes of a Research:

Generally, the aim of a research is the advancement of human knowledge. Specifically, a formal research may have one of the following purposes:

1. To discover facts and ideas not previously known
2. To test existing theories and explanations for various issues and subjects
3. To achieve better and more complete understanding of something
4. To find causes behind specific occurrences and events
5. To discover new techniques and methods for things if existing one are not yielding satisfactory results
6. To improvise and redefine a product to increase sales, and many more.....

Qualities of a Good Researcher:

- Curious
- Probing and a detective
- Critical thinker
- Creative
- Disciplined
- Hardworking and courageous
- Determined and strong-willed

- Intuitive
- Sincere and honest
- Risk taking

Importance of Research:

Research is the pumping heart of any field of study and inquiry. Crafts, techniques, technology, methodologies: everything becomes outdated and obsolete with the passage of time. The reason for this is man's thirst and passion for more information, knowledge, and improvisation; in short, research. Continuous researches and experimentations are realized as innovation and modernization. Therefore, societies lacking research culture simply fail to keep up with the pace of developed countries in the race of advancement and progress.

STEPS IN CONDUCTING A SYSTEMATIC SCIENTIFIC RESEARCH

STEP 1: SEARCHING FOR A PROBLEM TO INVESTIGATE:

In this context, the word 'Problem' means an issue, a question, a problem, a technique, a difficulty, etc which a researcher aims to study and investigate thoroughly.

Our earliest ancestors were intrigued by questions such as,

- What are the lights in the sky?
- What makes the grass grow?
- How deep is the sea?
- How far is the moon?

The basics of 'new' science are found in primitive people's ability to identify and articulate the unknowns of life and in their crude attempts to find solutions to such questions. Civilization grew as humans observed the phenomena of their world, recognized and isolated their problems, investigated them, and arrived at answers.

Therefore, a systematic scientific research begins with the recognition and selection of a problem to investigate. After selection, the problem needs to be stated in the form of a clear, guiding, and controlling statement or question. Dewey, a famous research expert, maintains that, "A problem well put is half solved".

The problem helps researchers decide what direction they must take, what is relevant and what is not, what methodology will work, etc. In this way, the problem guides them in reaching the correct answer to the question.

Here are some guidelines to help you select and define your problem:

1. Is the problem important or significant? Is the question worthwhile for the expenditure of time, energy, and funds involved? What is its societal relevance?
2. Can the problem be stated in question form? Finding the answer then becomes the objective of the study.
3. Can the problem be delimited and narrowed? Can boundaries be defined?
4. Are resources of information available and the state of the art practical?

5. Does it interest you?
6. Do you have the required background to undertake the inquiry under question?

There are three types of problems:

1. Problems of Fact: these problems seek answers to what the facts are. For example, 'Is the earth flat or round?'
2. Problems of Value: Problems of value are involved in setting up standards or criteria. Standards of safety, health efficiency, tolerance, economy, etc within a particular situation can be some examples.
3. Problems of Technique: Such problems concern the methods for accomplishing a desired result, like, 'How can a space station be launched in the mesosphere?'

Sometimes researches select a problem themselves, where as, mostly, they are hired or assigned the problem to investigate by some authority.

Hypothesis: A hypothesis is a tentative solution or answer to the problem. It is just a working guess. Scientists test their hypothesis by experiments. As a result of experiments, a hypothesis may be proved, disproved, revised, etc.

STEP 2: DETERMINING THE PURPOSE OF THE RESEARCH:

The problem can be stated as the issue which you want to investigate. On the other hand, the purpose is defined as the reason why the investigation is undertaken. It seeks to answer the following questions?

1. What is the purpose of this research?
2. Who needs the answers?
3. Who will use the answers?
4. What is the benefit of this research?
5. What is the limitation and scope of the research?

Write a specific purpose statement to avoid deviation from the research objective.

Study the example below:

Problem: What are the dietary needs of the elderly in nursing homes?

Purpose: To determine the dietary needs of the elderly in nursing homes so as to better satisfy and treat them.

Exercise: For the following research problems, try to generate specific purpose statements.

1. How can heat loss be prevented in a two-storey brick house?
2. How are writing skills taught in the secondary section of government schools?
3. Why did the coliseum roof collapse?
4. How can the overeating of non-vegetarian food affect a person's spirituality?
5. What are the factors behind the increasing criminal activities in Karachi?

HOW TO WRITE A PROBLEM STATEMENT STEP BY STEP

A problem statement is a statement of a current issue or problem that requires timely action to improve the situation. This statement concisely explains the barrier the current problem places between a functional process and/or product and the current (problematic) state of affairs. This statement is completely objective, focusing only on the facts of the problem and leaving out any subjective opinions. To make this easier, it's recommended that you ask who, what, when, where and why to create the structure for your problem statement. This will also make it easier to create and read, and makes the problem at hand more comprehensible and therefore solvable. The problem statement, in addition to defining a pressing issue, is a lead-in to a proposal of a timely, effective solution.

1.1 WHY IS A PROBLEM STATEMENT IMPORTANT?

A problem statement is a communication tool. Problem statements are important to businesses, individuals and other entities to develop projects focused on improvement. Whether the problem is pertaining to badly-needed road work or the logistics for an island construction project; a clear, concise problem statement is typically used by a project's team to help define and understand the problem and develop possible solutions. These statements also provide important information that is crucial in decision-making in relation to these projects or processes.

1.1.1 Problem statements have multiple purposes

The problem statement has other purposes, too. One is to identify and explain the problem in a concise but detailed way to give the reader a comprehensive view of what's going on. This includes identifying who the problem impacts, what the impacts are, where the problem occurs and why and when it needs to be fixed. Another purpose of the problem statement is to clarify what the expected outcomes are. Establishing what the desired situation would look like helps provide an overarching idea about the project. The proposed solution and scope and goals of the solution are made clear through this statement.

1.1.2 Problem statements help guide projects

The problem statement provides a guide for navigating the project once it begins. It is continually referenced throughout the duration of the project to help the team remain focused and on track. Near the completion of the project, this statement is again referred to in order to verify the solution has been implemented as stated and that it does indeed solve the initial problem. This can help in making sure that proper steps are being taken to prevent the same problem from happening again in the future.

Bear in mind that the problem statement does not attempt to define the solution, nor does it outline the methods of arriving at the solution. The problem statement is a statement that initiates the process by recognizing the problem.

1.2 HOW TO WRITE A PROBLEM STATEMENT

A problem statement is a tool used to gain support and approval of the project from management and stakeholders. As such, it must be accurate and clearly written. There are a few key elements to keep in mind when crafting a problem statement that can have a positive impact on the outcome of the project.

1. Describe how things should work.
2. Explain the problem and state why it matters.
3. Explain your problem's financial costs.
4. Back up your claims.
5. Propose a solution.
6. Explain the benefits of your proposed solution(s).
7. Conclude by summarizing the problem and solution.

1.2.1 Describe how things should work

To begin, you'll want to provide some context that will make it easier to understand the problem. Start by explaining how this particular process should work. Concisely describe how the process would function if the current problem didn't exist before mentioning the problem, keeping the end-user in mind. For example, let's say that you have an idea of how to increase efficiency in a process to maximize the best use of resources. You might begin by describing a theoretical situation in which the system is more efficient and working toward your proposal from there, always keeping in mind who, what, when, where and why to keep yourself on track.

1.2.2 Explain the problem and state why it matters

The problem statement should address not only what the problem is, but why it's a problem and why it's important to solve it. This will wrap the other 'W' questions in organically, in most cases. For example: Why should we fix this problem? Because it affects the efficiency of departments X, Y and Z, wasting resources and driving prices up for consumers. This addresses what the problem is, who is affected and why the problem should be fixed. You may also consider including what attempts have already been made to solve the problem and why they didn't work out. As concisely as possible, explain everything you know about the current problem.

1.2.3 Explain your problem's financial costs

When you state the problem to decision-makers, you'll want to explain the costs of not fixing it. Seeing as money is the language in which businesspeople speak, it's easiest to frame the problem and proposed solution in terms of financial costs. For example, if the problem is actively costing unnecessary money, preventing the company from making more money or damaging the company's public image (indirectly costing money) make sure you explain it specifically and clearly in terms they understand. Try to pinpoint exact dollar amounts for the problem's cost.

1.2.4 Back up your claims

Once you claim the problem is costing the company money, you must be prepared to support your claims with evidence. If you neglect this step, you may not be taken seriously. Do your research, cite your sources and have the data ready to present.

1.2.5 Propose a solution

The problem statement should describe your proposed solution(s) to the problem. At this point, you won't be focused on finding a single solution, but you should have a solid grasp on the causes of the problem and be prepared to propose practical approaches to understanding and remedying it. State your objectives by suggesting well-thought-out plans for attacking the problem.

1.2.6 Explain the benefits of your proposed solution(s)

Now, you've described an ideal scenario in which the problem doesn't exist. You've pointed out the problem, explaining the ramifications of choosing not to fix it (using dollars and solid data) and proposed some realistic approaches to finding a solution. Now is a very good time to demonstrate why this solution will work, again focusing on efficiency and the financial impact of your solution. Address what expenses the solution will decrease, how this solution will free up revenue streams and what intangible benefits, such as increased client satisfaction, your solution will bring. This should all fit into a single short paragraph.

1.2.7 7. Conclude by summarizing the problem and solution

Now you'll move onto your conclusion. This should consist of the problem, why it needs to be fixed and a summarized argument of why your solution is the best answer to the problem.

Following this format will help all parties who read it to understand the problem and be open to considering the best solution.

1.3 EXAMPLE

Problem statements usually follow the same general format, though they can fluctuate in length depending on the complexity of the situation. Here's an example of a basic problem statement:

Problem: Voter turnout in the southwest region of Florida has been significantly decreasing over the past decade, while other areas of the state continue to see increasing numbers of voters at the polls.

Background: Surveys conducted by the Florida Voter's Association suggest that voter turnout is lowest among people between the ages of 18 to 25 and low-income households (making under \$30,000 annually for a two-person household). The research conducted on voting patterns in other southern U.S. states suggests that this could indicate a broader trend, but this region's demographics suggest that it could become a more significant problem [expand and explain with sources]. Other parts of the country have made attempts, and succeeded, to a degree, to improve

voter turnout, but similar solutions haven't had the desired effect here in southwest Florida [cite sources]. More research is needed on the reasons these attempts have failed and what strategies might have more of an impact on reaching younger and lower-income households.

Relevance: Areas with low voter turnout have historically been shown to have lower levels of social cohesion and civic engagement and higher numbers of instances of civil unrest. More recently, this has become increasingly concerning for parts of the U.S. [give examples and cite sources]. Data shows that when certain parts of society lack political representation, they're more likely to become increasingly disillusioned over time, eroding society's trust in democracy and systematically triggering challenges in governance [explanation and sources]. Addressing this problem will give regional parties much-needed insights to help them adjust their policies and campaign strategies to include more of the residents of this region. It will also contribute to gaining a more nuanced understanding of voter behavior trends.

Objectives: The purpose of this research is to examine proactive engagement plans to increase voter turnout in the southwest region of Florida. It will distinguish the largest determinants in non-voting through surveys, interviews and social experiments designed to observe the impact of each of these strategies on voter turnout.

STEP 3: GATHERING BACKGROUND INFORMATION ON YOUR TOPIC:

With purpose and research problem narrowed and finalized, the next most important step is to gather all information that already exists on the subject under study. For this, refer only to established material. You will report this information in the chapter titled “Review of Literature” or “Background” in your report.

This step is very important because a researcher can not make a worthwhile contribution if s/he is completely ignorant of what is already known about the problem. A good literature study can sometimes even yield answers to a research question. Literature review is done to achieve two goals: to find already available information about the problem, and to acquire a good background in the area of research.

Literature on any subject can be found in libraries, digital libraries, automated data and information systems. Browse through the catalog of holdings in a library. Type of texts you will read would be

1. Standard Encyclopedia
2. Handbooks (Compact reference manuals containing the state-of-the-art data and information on particular subjects)
3. Standard Subject Textbooks
4. Periodicals (Read through the abstracts of researches)
5. Research reports, surveys, case studies, research papers, conference presentations
6. Established websites
7. Articles written by reliable writers in magazines, etc
8. Interviews of experts

While conducting literature search, take notes to record findings (material, facts, opinions, historical background, etc). Also, write the names of the books, journals, etc from where you are collecting information. Remember to write the title, author, page number, year of publication, and publication house. This is important to avoid plagiarism.

STEP 4: PREPARING A RESEARCH DESIGN:

Research design is the military plan of attack you make to conduct your research. It includes the following:

1. Information and data collection methodology/tools
2. A plan or procedure with tasks sequentially and logically arranged

A schedule of tasks with deadline Your research purpose, problem under study, resources, time allotted, and the report's word limit are the factors which will help you prepare a suitable research design. Let's study different data and information collection tools in detail.

a. OBSERVATION:

A common and traditional means for conducting research is through direct observation-a cornerstone of the scientific method. Observation is a serious and careful examination of object or issue under study. Follow the instructions below for a good observation to get the required data:

1. Select venue, and obtain permission from the owner.
2. Arrange access for an appropriate length of time.
3. Carry a notebook, camera, tape recorder with you.
4. Have a clear conception of the phenomena to be observed.
5. Try to ignore any preconceived notions or opinions you have in order to be objective and honest.
6. Record what you perceive. Also, describe in detail what you find.

b. EVALUATION/CRITICAL ANALYSIS:

Evaluation is systematic determination of merit, worth, and significance of something or someone using authentic criteria (a set of standards).

c. EXPERIMENTING:

In experiment, events are made to occur under known conditions. Follow the instructions below for conducting experiments if required in your research:

1. Work out the procedure of the experiment.
2. Make sure you are aware of any precautionary measures that are to be taken.
3. Get the apparatus, equipment, devices, and other things that you will require.
4. Conduct the experiment.
5. Jot down the findings

d. INTERVIEWS:

There are two types of research interviews:

1. *Structured Interview:* A structured interview (also known as a standardized interview or a researcher-administered survey) is a quantitative research method commonly employed in survey research. The aim of this approach is to ensure that each interview is presented with exactly the same questions in the same order. Structured interviews are a means of collecting data for a statistical survey. A structured interview also standardizes the order in

which questions are asked of survey respondents, so the questions are always answered within the same context. It generates objective numerical data.

2. *Semi-Structured Interview:* A semi-structured interview is flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says. The interviewer in a semi-structured interview generally has a framework of themes to be explored.

Here are some points to consider for a successful interview:

1. Select the right person(s). Find out his/her position/designation.
2. Make a definite appointment by telephone, letter, or email.
3. Now, prepare for the interview by formulating the right questions so that you get the desired information.
4. Tape the interview. If not possible, then take notes.
5. Arrive on time.
6. Do only as much talking as is necessary.
7. If the interviewee gets off the subject, be ready with a question that can get him/her back on track.

e. **QUESTIONNAIRES:**

Questionnaires require judicious handling. It should be designed to require as little time as possible for completion. Some guidelines for designing suitable questionnaires are:

1. First jot the questions you require.
2. Then phrase questions as short sentences. Avoid very lengthy questions.
3. Choose the words to be clear and precise.
4. The first few questions should be easy so that you can secure cooperation of the participants.
5. One question should stimulate interest in the other.
6. Questions should be designed in such a way that a yes, no, one-word answer, ticking an option, etc would be enough to answer it.

For questions, whether used in an interview or a questionnaire, the following is important to understand. There are different type of questions:

1. **Closed Questions:** A closed question usually receives a single word or very short, factual answer. For example, "Are you thirsty?" The answer is "Yes" or "No"; "Where do you live?" The answer is generally the name of your town or your address. Closed questions are good for:
2. **Open Questions:** Open questions elicit longer answers. They usually begin with what, why, how. An open question asks the respondent for his or her knowledge, opinion or feelings. "Tell me" and "describe" can also be used in the same way as open questions. Here are some examples:

- What happened at the meeting?
- Why did he react that way?
- How was the party?
- Tell me what happened next.
- Describe the circumstances in more detail.

3. **Funnel Questions:** This technique involves starting with general questions, and then homing in on a point in each answer, and asking more and more detail at each level. It's often used by detectives taking a statement from a witness:

"How many people were involved in the fight?"

"*About ten.*"

"Were they kids or adults?"

"*Mostly kids.*"

"What sort of ages were they?"

"*About fourteen or fifteen.*"

"Were any of them wearing anything distinctive?"

"*Yes, several of them had red baseball caps on.*"

4. **Leading Questions:** Leading questions try to lead the respondent to your way of thinking. They can do this in several ways:
- With an assumption: "How late do you think that the project will deliver?". This assumes that the project will certainly not be completed on time.

Leading questions are good for:

- Getting the answer you want but leaving the other person feeling that they have had a choice.
- Closing a sale: "If that answers all of your questions, shall we agree a price?"

STEP 5: SYSTEMATIZING, ANALYSING, AND INTERPRETING THE DATA:

The data you have obtained from your investigation now needs to be systematized, organized, and interpreted to find answers to your research problem.

How to Systematize Your Data: Arrange and organize your data by grouping it into different parts. Each part will bear information to a particular element or aspect of your problem. Give headings to each part of the data, and sub-headings if required.

How to Analyze and Interpret Your Data: Analysis and Interpretation will require you to use a range of critical thinking skills like:

1. Examining
2. Analyzing
3. Conceptualizing
4. Defining
5. Inferring
6. Understanding facts, opinions, assumptions, etc
7. Evaluating

Study each part of the data stepwise and record your findings. By this time you will have found the answer to your research problem. Now it's time to report your findings to the world. So we move to the next step which is as challenging as the research itself.

STEP 6: WRITE A REPORT TO SHARE THE RESULTS WITH THE WORLD:

The next chapter discusses report writing in great detail.

WRITING TECHNICAL REPORTS:

A Reconstruction of an Investigation

A technical report is a document that describes the process, progress, or results of technical or scientific research or the state of a technical or scientific research problem.

A report is written to communicate factual and objective information obtained after a careful scientific research or scrutiny. It is usually written for a well-defined audience. The audiences require this document for an important well-defined purpose.

Importance of a Report:

- Reports are written for specific individuals because these individuals need the information for future actions.
- Reports add to the body of knowledge by conveying important opinions and findings which then serve as a basis for further progress and advancement.

Types of Reports (Functional):

1. **INFORMATIONAL REPORT:** An informational report provides information about a specific topic. It does not offer criticism, evaluation, or recommendations. It would discuss past and present information on a topic. For example, news reports, weekly or monthly or annual reports on sales, production, or progress, etc.
2. **ANALYTICAL OR EVALUATIVE REPORT:** This type of report contains an analysis and evaluation of findings along with the presentation of facts. It may contain conclusion, recommendation, opinions, etc as well.

Types of Reports (General):

1. **Research Report:** It communicates the results and the procedure of scientific investigation.
2. **Feasibility Report:** It tells whether a project is feasible-that is, whether it is practical or financially and technologically possible.
3. **Recommendation Report:** It studies a problem or opportunity and then makes a recommendation. It may compare two or more alternatives and recommend one.
4. **Laboratory Report:** It documents laboratory procedures and their results.
5. **Periodic, Progress, and Trip Report:** It communicates progress on projects and events to those concerned with their completion and success. Readers review, and may revise, scheduled courses of action as a result of information included in these reports.
6. **Personnel Evaluation Report:** It reviews the performance of employees.

Elements/Components of a Report with a Standard Organizational Pattern:

COVER MATERIALS:

- Cover and title page
- Cover letter or memo (optional)
- Invoice (optional)
- Letter of Transmittal

- Abstract
- Acknowledgements
- Executive Summary
- Table of contents
- List of figures or illustrations
- List of tables

BEGINNING OF THE REPORT:

- Introduction:
 - The purpose of the investigation
 - The research problem (its nature)
 - Significance of investigating the problem
 - Scope or limitation of the research
 - A list of personnel engaged in the research with a brief sketch of their background and duties (optional)
 - Organization of the report
- Historical Background (Review of Literature):
 - Background information on the problem
 - Known facts, opinions are discussed
 - Nomenclature, definitions are given for new or unusual terms or those having a specialized meaning
 - A list of symbols, acronyms, and abbreviations

In small scale research reports, all the items above are written in a single chapter with clear defining headings. However, in large scale research reports, 'Introduction' and 'Historical Background' are written as two separate chapters as there would be a lot of information and details to convey.

BODY OF THE REPORT:

- Discussion of research methodology (for a small scale research, this would be very brief)
- Analysis of data, results, findings, Discussion of results

ENDING OF THE REPORT:

- Conclusions
- Recommendations and alternatives (optional)
- References
- Bibliography
- Appendix
 - Raw data (Questionnaires, interview questions, checklists)
 - Notes taken during observations
 - Rough results of experiments
 - Tables or charts, photographs, etc

How to Write the Elements of the Report:

COVER & TITLE PAGE:

The title page must have the following features:

1. Neat and organized
2. Clearly indicates the subject title in the upper half of the page
3. The title of the report should specifically identify both the report's function and subject
4. The person or organization writing the report and the person or organization receiving the report, the date of submittal appear in the lower half of the page

Look at the example below:

<p style="text-align: center;">FEASIBILITY STUDY OF OFFICE EXPANSION FOR UNITED COMPUTER TECHNOLOGIES, INC.</p> <p style="text-align: center;">Prepared for Joanne R. Galloway Senior Vice President United Computer Technologies, Inc</p> <p style="text-align: center;">By William D. Santiago Senior Partner PRT Management Consultants, Inc.</p> <p style="text-align: center;">March 3, 2021</p>
--

EXERCISE: Design a title page using the information given below:

1. Geologic Report on The Physiographical Development of the Colorado Piedmont Area
2. By Maurice De Valliere, Geology Student
3. Submitted to Dr. Herman M. Weisman, Professor of Technical Journalism, Colorado Polytechnic University, Fort Collins, CO 80521
4. November 30, 2020

LETTER OR TRANSMITTAL:

The letter of transmittal is addressed to the official who authorized the report and is signed by the official authorized to produce the report. It is the official acknowledgement of completion of the report and includes a statement of its transmittal. It contains the following information:

1. The title and subject of the report
2. Can include a very brief summary
3. It can acknowledge those who assisted in preparing the report
4. It has a formal tone.

Study the sample letter of transmittal below and try to write one for your own project.

December 9, 1982

David McMurrey, Chairman
Coastal Real-Estate Developers
400 Baywater Blvd.
Corpus Christi, Texas

Dear Mr. McMurrey:

As agreed in our September 21 contract, we are submitting the attached report entitled *The Effects of Increased Atmospheric Carbon Dioxide*.

This report examines the problem of CO₂ accumulation in the earth's atmosphere. The climatic changes caused by excessive CO₂ concentrations in the atmosphere, and the implications of these changes, will be discussed. Also discussed are the mechanisms of the greenhouse effect, the sources of atmospheric carbon dioxide, and some possible remedies to the problem.

I hope you find this report satisfactory.

Sincerely yours,

William R. Waters, President
Environmental Research Associates, Inc.
1212 Trace Dr., Suite 3
Austin, Texas 78741

WRW:mb
Enclosures

ABSTRACT:

An abstract tells the potential reader the contents of the report. An abstract gives the gist of essentials of the investigation or the contents of the report. It may explain the problem and how it was studied. It gives enough description that would be sufficient for the reader to determine whether the report pertains to their interest or not. It has a standard word limit from 100-250 words depending on the size of the report.

Study the example below:

Abstract

This report investigates the current state of scanner technology and examines the predicted future advancements of scanners. A brief history of the scanner and its operation is initially outlined. The discussion then focuses on the advantages and limitations of the five main types of scanners in common use today: drum, flatbed, sheet-fed, slide, and hand held scanners. The performance of these scanners is examined in relation to four main criteria: resolution, bit-depth, dynamic range and software. It is concluded that further technological advances in these four areas as well as the deployment of new sensor technology will continue to improve the quality of scanned images. It is also suggested that specialized scanners will increasingly be incorporated into other types of technology such as digital cameras.

EXERCISE: Read the abstract below and answer the questions that follow.

ABSTRACT

Software Quality Assurance (SQA) is a group of related activities employed throughout the software life cycle to positively influence and quantify the quality of the delivered software.

This report provides an overview of SQA, outlining process and product assurance and the methods and technologies typically employed to accomplish them. These methods include audits, assessment activities (e.g., ISO 9000), analysis functions such as reliability prediction, and embedded defect detection methods such as formal inspection. The overview is intended to help the reader identify specific SQA activities for more in-depth study.

This report also describes several representative publications on the subject of software quality assurance, assessment standards, and inspection to help the reader find a reliable source for further research. It concludes with an annotated bibliography of public-domain papers on the subject of SQA.

1. What is the purpose of the report?
2. What are limitations of this report?
3. Write a clear title for this report?
4. How does this study benefit society?
5. Who might be the target readers of this report?

Read the following abstract and identify background, method, findings, and conclusion. Note the verb tenses in each section:

Proteomics-based approaches complement the genome initiatives and may be the next step in attempts to understand the biology of cancer. We used matrix-assisted laser desorption/ionisation mass spectrometry directly from 1mm regions of single frozen tissue sections for profiling of protein expression from surgically resected tissues to classify lung tumours. Proteomic spectra were obtained and aligned from 79 lung tumours and 14 normal lung tissues. We built a class-prediction model with the proteomic patterns in a training cohort of 42 lung tumours and eight normal lung samples, and assessed their statistical significance. We then applied this model to a blinded test cohort, including 37 lung tumours and six normal lung samples, to estimate the misclassification rate. We obtained more than 1600 protein peaks from histologically selected 1mm diameter regions of single froze sections from each tissue. Class-prediction models based on differentially expressed peaks enabled us to perfectly classify nodal involvement with 85% accuracy in the training cohort. This model nearly perfectly classified samples in the independent blinded test cohort. We also obtained a proteomic pattern comprised of 15 distinct mass spectrometry peaks that distinguished between patients with resected non-small-cell lung cancer who had poor prognosis (median survival 6 months, $n=25$) and those who had good prognosis (median survival 33 months, $n=4$, $p<0.0001$). Proteomic patterns obtained directly from small amounts of fresh frozen lung-tumour tissue could be used to accurately classify and predict histological groups as well as nodal involvement and survival in resected non-small-cell lung cancer.

Yanangisawa, K. et al. Proteomic patterns of tumour subsets in non-small-cell lung cancer. Lancet 2003; 362: 433.

Read the following abstracts of the reports, and revise them if they require improvement:

1. The risk taking tendency of entrepreneurs of new and old ventures has been objectively obtained using questionnaire and personally administered interviews. Relevant research from a number of business personalities is summarized. The model is intended to be a preliminary concept of risk taking in business. The findings suggest that risk taking has been profitable for entrepreneurs. The research can be modified by adding strategic risk management techniques and decision making.
2. In most of developing countries such as Pakistan electioneering process normally yields unjust results such as double registration, votes by ineligible voters etc. Whereas, electronic voting like, Biometric system of voting in elections is more reliable and efficient at the present era, this has been proved by the approval of this system in KPK region of Pakistan for upcoming provincial elections, although there are certain limitations to biometric systems like some of the genuine registered voters are not recognized, eligible voters are

disfranchised due to software bugs, some citizens that are physically challenged with no fingers are also denied to vote because the system used for the registration made use of fingerprints only. This paper will confer comparison between old-fashioned (Polling System) and modern (e-voting) systems of voting. The paper proposes some technologies to eradicate the problem of eligible registered voters disfranchised by the biometric system like a multi scan system that allows citizens to use other body parts instead of fingerprints alone. The proposed system for general elections will create room for full participation of all eligible voters, eliminate multiple voting and also increase the confidence of the people in Pakistan in the electioneering process. Till now we have establish that e-voting like Biometric system is far better and advantageous than polling system in yielding transparent results despite of its limitations but there are ongoing projects to overcome these limitations. In this context we will collect research information mainly by using convenience sampling technique and surveying some particular people of Pakistan and will also take some interviews of NADRA or other government officials.

3. Information Technology (IT) has revolutionized the entire world, doesn't matter of which field you are talking about, it has grabbed each and everyone's attention to it. From dawn to dusk we are surrounded by multiple application of IT. This study was designed to serve as comprehensive development report on the future of IT in Pakistan. In this context, the study aims to give small attention to important changes that occurred in IT since independence and a lot to what is expected in next 10 years from Pakistan, especially in terms of usage. IT is concerned with the improvements in a variety of human and organizational problem-solving endeavors through the design, development, and use of technologically based systems and processes that enhance the efficiency and effectiveness of information in a variety of strategic, tactical, and operational situations. We have surveyed many individuals related to IT which includes users, IT professionals, IT teachers, and IT students to collect the data using convenient sampling. The study is a qualitative and quantitative analysis based on information taken from both secondary and primary information. The discussion concentrates on structure, access, quality, and future prospects of information technology in Pakistan. Statistical analysis of this study predicts that in next 10 years Pakistan is going to be one of the most promising centers of IT in the world and will be valued more than now.
4. Online shopping is slowly becoming a social norm all along the world. With the ease of just a few simple clicks involving a simple process of selection and transaction, one can easily purchase virtually anything he would want. Online shopping has expanded in recent to items such as machinery, home accessories, work equipment and even groceries. Especially in Karachi, one of the largest cities of the world as well as one of the fastest growing, online shopping is quickly growing in popularity. There are still some reasons due to which people hesitate from online buying. The attitudes of the people towards buying online are different. Some refuse to use it as they are simply unaware of the features available to them. Some prefer not to as they are doubtful when it comes to online consumer privacy and security. This study will focus on these reasons and which things they are

dependent on. The statement of the problem is that whether people today prefer shopping online or would rather shop in the more traditional and conventional method of going to the store themselves. There is very limited knowledge about online consumer behavior because it is a complicated socio-technical phenomenon and involves too many factors but our methodology will focus on the most important and vital variables which will prove an accurate result to prove our hypothesis. Focusing on a variable amount of locations which will mimic the ratio of types of population within the city, an estimated sample size of 400 people covering an age demographic of young adults to elderly people, we plan on collecting information using online forms and spreading questionnaires.

5. We conducted a statistical Survey on

“Contradictions in social and religious believes in Pakistan”

in order to determine the existing state of mind or in more layman terms the “thinking/mentality” of the different oriented societies existing in Pakistan and hence reaching to a more realistic observation. To do so we distributed and urged people with distinguishing mindset to go through the survey and fill them out. We reached our own universities colleagues as well as collected surveys from notable institutions so that we can attain a result that has no chance of being bias. We distributed and collected the surveys from wide range of people from being a student ,to being a normal citizen. From being a conservative to being a liberal and most of all the Contradictive. We also conducted online surveys to extend our research further and also to get data from the supposed educated and modern people. Distinguishing people from their thoughts is the best way to filter out the existing approach and frame of mind of the society. Hence we adopted this same procedure by dividing people by their Thoughts and then entering the data of the surveys in Statistical Software to reach to a conclusion. We compiled all our data in SPSS and did all the mathematics to reach to a conclusion. The result is then determined by comparing the actual data with the standard set at the beginning by ourselves to conclude if Contradiction exists or not. If the results are inclined towards either Conservative or liberal Standards then we conclude that there is no Contradiction in the society.

6. The intense power crisis has an overall adverse effect on the development and progress of any country. The purpose of this paper is to determine the REAL and actual reasons for the power crisis in Karachi; the reasons, NOT those which are commonly known by the people through common unreliable sources, but the reasons which are actually the cause of power crisis in Karachi, the production level and industrial level reasons which are the real major cause of the crisis. Hypothetically this research revealed that the factor of insolvability of power crisis comes not under the authorities of the power generation or distribution plants, but it is majorly a result of mismanagement and lack of governance. The data collected is majorly on exploratory basis from personal investigation of technical personnel related to the power sector. The findings revealed expected results; the Karachi Electric is capable of producing enough power for the whole of Karachi but they are being given a limited amount of resources, like gas or oil. According to 70-80 percent of technical people related to power sector, the crisis is majorly due to a mere mismanagement and lack of governance at the upper hand. Along with the alternate sources, Pakistan should rely on some permanent and long lasting sources of power production such as nuclear power. Despite of

its heavy investment, nuclear power is cheaper once installed and repays the investment in a very short period of time.

EXECUTIVE SUMMARY:

Executive summaries are written for busy administrators and decision makers who will not have the time to read the entire report. Also, executive summary is written to save a person from reading a report on issues or subjects in which s/he lacks the required background. Guidelines for writing a good ES are:

1. Read the entire report to grasp its full content.
2. Your summary should be one-quarter of the original text.
3. Write persuasively to motivate readers to read the report.
4. Discuss your research problem, the purpose of the study, the methodology used, the findings and results. Also, make recommendations if required.
5. Use headings to facilitate reading.
6. Be simple and formal.

Study the example ES below:

Executive Summary

This report provides an analysis and evaluation of the current and prospective profitability, liquidity and financial stability of Outdoor Equipment Ltd. Methods of analysis include trend, horizontal and vertical analyses as well as ratios such as Debt, Current and Quick ratios. Other calculations include rates of return on Shareholders Equity and Total Assets and earnings per share to name a few. All calculations can be found in the appendices. Results of data analysed show that all ratios are below industry averages. In particular, comparative performance is poor in the areas of profit margins, liquidity, credit control, and inventory management.

The report finds the prospects of the company in its current position are not positive. The major areas of weakness require further investigation and remedial action by management. Recommendations discussed include:

- 🔹 improving the average collection period for accounts receivable.
- 🔹 improving/increasing inventory turnover.
- 🔹 reducing prepayments and perhaps increasing inventory levels

The report also investigates the fact that the analysis conducted has limitations. Some of the limitations include: forecasting figures are not provided nature and type of company is not known nor the current economic conditions data limitations as not enough information is provided or enough detail i.e. monthly details not known results are based on past performances not present

subject matter

methods of analysis

Findings

Conclusions

Recommendations (note that conclusions and recommendations can be bulleted)

Limitations of the report.

Executive Summary 2

This report was commissioned to examine why the sales volume of Choice Chocolate has dropped over the past two years since its peak in 1998 and to recommend ways of increasing the volume.

The research draws attention to the fact that in 1998, the market share of Choice Chocolate was 37%. The shares of their key competitors such as Venus and Bradbury were 22% and 18% respectively. The size of the chocolate market then was \$36 million. Over the next two years, although Choice Chocolate retained its market share the volume of sales in the whole market decreased to \$29 million. Further investigations reveal that this market shrinkage coincided with an increase in health awareness amongst consumers who regard the milk and sugar ingredients in chocolate as negative; moreover, since the second half of 1999, an increasing number of rival 'health candies' had appeared on the market. These claimed to offer the consumers a healthy alternative. These factors appear to be the major causes of the decreased sales volume of Choice Chocolate.

Slim Choice is the latest chocolate range put forward by the R & D Department of Choice Chocolate. The report evaluates this range and concludes that it would be an ideal candidate to meet the challenge presented by the market and could satisfy the new consumer demand since it uses significantly reduced milk and sugar ingredients and is endorsed by renowned health experts. According to 97% of the 2000 subjects tested recently, it also retains the same flavour as the original range. It is recommended:

- ☛ that Choice Chocolate take immediate measures to launch and promote Slim Choice alongside its existing product range;
- ☛ that Slim Choice adopt a fresh and healthy image;
- ☛ that part of the launch campaign contains product endorsement statements by renowned health experts;
- ☛ that Slim Choice be available in health food shops as well as in traditional chocolate retail outlets

Executive Summary 3

Every time a business or consumer purchases products or services they display forms of buyer behaviour that are influenced by many factors. The following report looks at the fast food industry and will analyse four McDonalds' key products and services. It highlights what type of consumer buying or business buying behaviours are displayed in the purchase of a product or service and explains why each behaviour may occur. This enables a conclusion to be drawn from applying theory to reality. Although a full comprehension of buying behaviour is impossible, since everyone is an

Terms of reference
Statement of problem/ topic

Formal language appropriate to report writing

Key findings summarised

Problem solution summarised

Recommendations summarized

Background to problem

Report's aims
Outlines what information the report deals with but FAILS to provide a summary of the results gained, conclusions drawn and recommendations made. These are the functions of an executive summary and are

individual, it is useful to reflect on common behaviours and attempt to divide behaviours in types and stages. Even McDonalds, a leader in marketing cannot always predict consumer behaviour.

absent in this example. The information in this executive summary is vague rather than summarising what the report found.

TABLE OF CONTENTS/LIST OF FIGURES/TABLES:

A well-constructed table of contents helps readers determine the subject matter of the report, its organization, and the location of sections of interest. Divide the material into major headings, subheadings, and further subheadings. Number all the headings for quick reference. Two formats for numbering headings are:

1. The traditional (I.,I.A.,I.A.1, and so on)
2. The multiple decimal format (1.0,1.1.1,1.1.2,1.2,1.2.1 and so on)

Study the example below:

TABLE OF CONTENTS

Letter of Transmittal	i
Abstract	ii
Executive Summary	iii
1.0 Introduction.....	1
1.1 Review of Related Literature	1
1.2 Statement of the Problem.....	3
1.3 Objectives of the Study	3
1.4 Research Questions.....	4
1.5 Significance of the Study	4
1.6 Limitation and Delimitation of the Study	4
1.7 Research Methodology	5
1.8 Sampling Technique.....	5
1.9 Research Instrument.....	6
1.10 Instrument's Reliability	6
1.11 Ethical Consideration.....	7
1.12 Research Procedure.....	7
2.0 Data Analysis and Statistical Tool	8
2.1 Findings of Qualitative data.....	10
2.1.1 Thematic Analysis	10
2.1.1 Theme-I-Instructional leadership is a shared phenomenon seeks to involve all stakeholders.....	10
2.1.2 Theme 2- Instructional leaders establish linkages at whole-school level.....	10
2.1.3 Theme 3. Principal's indirect involvement in instructional leadership meant empowerment of vice-principals and teachers.....	11
2.1.4 Theme 4: Instructional leadership promoting academic achievement and encourage Co-curricular activities.....	12
3.0 Discussion.....	13

3.1 Recommendations based on the Findings.....	14
3.2 Recommendations for the Future Research... ..	15
4.0 Conclusion... ..	16
5.0 References.....	17
Appendixes	

INTRODUCTION OF THE REPORT:

Introductions contain details on research purpose, problem, and the rationale for the investigation. It points out the scope of the study. It discusses the background of the research problem with a review of its literature.

EXERCISE: Critically analyze the 'Introduction' of a report given below. Does it contain literature review.

Report on DVD TECHNOLOGY AND APPLICATIONS

I. INTRODUCTION

Digital Versatile Disc, or DVD is a collection of new optical disc technologies that have the potential to significantly improve the quality of a number of consumer electronics and personal computer products. These discs are capable of holding up to 17 gigabytes (GB) of data storage, with current research offering a potential for 15 times more storage. This technology is made available through advances in laser technology and advances in manufacturing processes for optical discs. A Digital Versatile Disc is basically a double density, double sided, compact disc. In addition, the laser used to read a DVD utilizes a shorter wavelength, allowing the storage surface of each of these layers to be more compact.

The purpose of this report is to present the format, creation, current applications, and economic forecasts for DVD technology. To emphasize the advances afforded using this technology, a side by side comparison with current Compact Disc technology will be used. Motorola's Research and Development is currently investigating the possibilities for implementation of a DVD Group to interact with current research and product groups. This report will give the introduction and background necessary to determine the feasibility of DVD integration into current marketing and research products. This report will provide a simplified explanation of the construction methods required for DVD replication, solely for the purpose of presenting the difference in construction needed to manufacture a DVD.

The four parts of this report will discuss (1) a technological overview of DVD, utilizing a comparison of CD vs. DVD technologies, (2) the construction of a DVD, (3) current applications utilizing DVD, and (4) projected sales and revenues of DVD devices. The technological overview section will use a comparison of current CD specifications vs. DVD specifications to convey the advances made possible using DVD. The construction section explains the manufacture of a DVD to show the physical

advantages of DVD for data storage and retrieval. The section covering current applications examines the five current formats for DVD specifications and how they are currently being used today. Finally, the sales and revenues section includes forecasts of DVD sales and distribution, based upon current sales and technology release.

EXERCISE: INTRODUCTION OF A TECHNICAL REPORT

Match the following headings with the appropriate SECTION of the text in the table:

1. Existing work related to the project
2. The scope and limitations of the project
3. Assignment Definition
4. The field of study
5. Claims for the project
6. Outline of the procedure
7. The purpose

The principle of a "robot" is an ancient one. The word robot in Czech means labourer or worker. Commercial robots do not have the 'intelligence' to think independently. **This project** aims to address this inadequacy by improving existing robotic technology.

Thomas Ross built the first robot mouse in the 1930s, but subsequently robotics developed at a very slow pace until the late 1970s, when useful industrial **robots became a practical** proposition.

The project team had to build a computer controlled maid **robot that could successfully serve** drinks and food as ordered.

The mini-robotic toy described here, which we have built and called RoboMaid, is an important step in this direction in that it can serve cold drinks and food only. The use of computer control not only greatly increases the scope and capabilities of the robot, but the machine itself takes programming out the two dimensional world of the **visual display unit** into the three dimensional world.

Our objective was to produce a mini-robot which consisted of three units: the computing and processing unit, the transceiver unit and the driving unit.

A range of programming was developed so that the **e robot can sense its environment via the** sensing device coupled to its "shell". Although the robot is **able to serve cold drinks, it works** most effectively if only one type of drink is ordered.

We designed it to be controlled by 4 data lines derived **from the Motorola G4 Altivec** computer processor. Binary bits are used to control the motor drive circuits. By turning on, or off, different combinations of the bits 0-4, quite a variety of movements can be executed. The action of the control will be described in the software part. We used a transceiver unit which transmitted or received infra red and the signal was manipulated by the computing and processing unit.

Literature Review

Exercise#1

Chief Economists David Langdon, George, McKittrick, David Beede, Beethika Khan, and Mark Doms (July 2011) analyzed the STEM Education and STEM Jobs for the past and future 10 years

by using the sample of public through population surveys. Growth rate of STEM and Non STEM Employment, Occupations in STEM, Availability of Jobs, Workers and their wages, STEM diploma holders, undergraduates, degree holders and their average earnings has been used as variables. Comparisons of wages, Regression analysis, American Community Surveys, calculations of the regression-adjusted earnings techniques are used. Analysis of data shows that the growing rates of STEM jobs are the main cause to economic validity. They are essential in the development of technological and scientific innovations.

In 2012 Hispanic Scholarship Fund (HSF) examined the STEM occupation; this report is an excerpt from HSF's full-length College to Career analysis that profiles science, technology, engineering, and math (STEM) occupations. The analysis looked at recent college graduates' chosen fields of study and how they relate to the career opportunities available in a range of STEM industries and occupations. This data was then compared to the projected number of entry-level job openings from 2012 to 2018 in the highest-demand occupations of this sector. College graduates and number of employments are used as the variables. Bar charts and pie charts are used as techniques for comparisons. According to HSF's research "computer systems analyst" will be in demand till 2018.

Daniel Costa (2012) investigated that Microsoft Corporation recently published report which examines the number of American college graduates in computer science and all of the available job openings in computer-related occupations between now and 2020 in America. Shortage of workers in computer-related occupations, College graduates in Computer science, number of H1 visa allowed, number of STEM graduates has been used as variables. Linear regression approach has been applied which shows unemployment rate as the years progresses. Results have shown that in CS jobs opening less than one-fourth to less than one-half of workers in computing occupations have a computer science degree and the unemployment rate which Microsoft have provided is totally wrong as unemployment rate in America have never gone above 3.7. Once the unemployment rate for college-educated workers in computer-related occupations begins to approach the true measure of full employment for the occupation, it will make sense to debate whether new STEM green cards should be created and if H-1B levels should increase.

Ben Cover, John I. Jones, and Audrey Watson examines the STEM occupations its demands and employment occupation for guiding the youngsters about which field to choose by using the sample of Occupational Employment Statistics (OES) in May, 2009. Fields in demand, Employment and Occupation has been used as the variables. Bar Graphs used for simple comparisons, Bubble Chart and Data Mapping analysis have been applied. Result shows that the highest paying STEM occupation is "Natural Sciences Manager". The STEM occupations are increasing in the places where technology is evolving and these areas give high wages to their employees.

Michael Anft, Observed that the payment which technology workers get is fairly high then the Salaries which chemical, civil engineers get in America. This is due to the large number of job openings and less number of workers in IT department. Shortage of IT workers, salaries, number of jobs is the variables. Due to the shortage of IT workers private companies are forced to bring workers from different countries so that they can work on different projects but to bring them to America companies have to offer large sum of salaries and different packages which some times in the end becomes costly for companies. As a result companies now offer scholarships for high

School graduates so that they pursue BS CS degree and companies expect government to do the same.

Example#2

Afia Malik (2012) analyzed the crisis in Pakistan in terms of crisis in Governance. She found that the power crisis is majorly a result of internal crisis in governance. According to her study the demand supply gap resulted in a regular load shedding for up to twenty hours in several rural areas. Quick increase in demand, high system losses, and lack of generation lead to this gap. She found out that poor decisions, and bad governances lead to the downfall of the power sector in Pakistan. Power crisis is considered to be a core hurdle in the development of any country. Muazam Rashid Dar (2013) and Muhammad Azeem (2013) examined the impact of power crisis on the economy of Pakistan. They specifically determined and came up with the facts that power crisis adversely affects the economy of Pakistan to such a great extent. As economy is one of the building blocks of any nation's development, so is the case here. According to them, proper exploration of energy resources could be one of the optimal solutions to the power crisis.

Masnoon S. Ahmed (2005) studied the importance of nuclear power generation in the development. The reviews show that there has been consistent shortage of power since 2006-07 in Pakistan. And consistently the shortage of power is increasing every year. The reasons suggest that this is due to the improper and lack of infrastructure facilities. Masnoon S. Ahmed (2005) emphasized on the dependency on nuclear power as a solution for the power crisis.

As the population is rapidly growing, so is the demand of energy is increasing. Pakistan explores and exploits different energy resources such as gas, coal, petroleum and Nuclear energy, in order to fulfill its power requirements.

BODY OF THE REPORT:

This is the longest section of the report. It contains the following:

1. The research methodology: It contains a technical description of the research design. Second, it offers a rationale or justification for selecting the respective research methods (data collection methods). It discusses in detail the procedure with steps arranged in the right chronological order. It discusses the sampling strategy used along with a rationale for it.
2. It analyzes the data. Different elements of the data are analyzed separately by referring to the appendix for a closer look at the raw data mass. It discusses the answers that the data yield. It discusses everything that the data disclose. It presents the information in a highly organized and readable form. Use charts, graphs, tables, headings and subheadings, pictures, diagrams-anything that can ease the process of reading.
3. It utilizes many visuals (graphs, charts, diagrams, etc) to ease the presentation and explanation of key points.

EXERCISE: Critically analyze the body of the report below. It studies a problem and offers solutions. Also, study the conclusion.

A pencil is sharpened by an inclined rotating blade. The torque is generated by a motor through some form of transmission.

The motorised sharpener consists of a cutting blade, a push button, a motor, two shafts, two bearings, a set of compound spur gear trains and various dimensions of perspex that make up the casing.

This sharpener **is DC operated** with a three volt supply from batteries. The activated motor transmits a certain power to drive a compound gear train. The driving gears in turn drive the cutting blade of the sharpener to sharpen the pencil.

After designing the motorised pencil sharpener, analysis of the product **was required** before the assembly and manufacturing phase.

The information regarding the design of the motorised pencil sharpener **was arrived at** by drawings, an exploded three-dimensional view of the product and a prototype of the product. Following this, the design **was analysed** for manual handling and manual insertion using the Boothroyd Dewhurst method.

There were two problems encountered during the design stage: getting an appropriate and attractive shape and conforming to the given specifications.

This problem was solved through brain-storming sessions, consultation with lecturers and knowledge gained during the course of study at the Polytechnic.

Finally a design that was both attractive and within the specifications was created.

The assembly procedures of the motorised pencil sharpener are as follows:

- The motor together with its holder and pinion **were screwed** to the base using two self tapping screws.
- The driven gear **was fitted** tightly into the shaft. The residue plate was then slid into position.
- The sharpener holder was fitted tightly to the shaft and the sharpener was fastened to its holder with two capped screws.
- The whole assembly was aligned in such a way that it was directly below the hole in the top plate.
- The battery bracket was tightened to its holder and this together with the sharpener was fastened to the side plate with self tapping screws.
- The four side plates were glued together after the assembly of all the internal components.
- The contact switch was then screwed to the top plate using self tapping screws.

Finally the top plate and the contact switch were glued on to the top of the four side plates.

Once the assembly was completed the motorised sharpener was tested using a HB pencil.

The motorised pencil sharpener **was constructed**. However because of some manufacturing/assembly problems and time constraints, the sharpener did not cut the pencil properly.

One of the main causes for this could be the lack of proper alignment of the components.

The other possibility could be inadequate torque transmitted.

However, these problems could be overcome by taking the time for proper alignment and calculating appropriate transmission ratios.

THE CONCLUSION OF A REPORT

The concluding section of the report usually comprises three components as outlined below. Notice that the first component looks back at what has been done and the last two components look ahead or beyond your project using the new experience gained from your project.

1) Meeting of objectives

Here you are required to tell the reader whether you met your objectives, and if not, the extent to which you did meet them. If there was any change in your initial objectives you must give the reasons for this change.

2) Proposing/Recommending Design improvements to your project

Having worked on your project for some time, you may have thought of other ideas that could improve your piece of work in terms of its cost, efficiency to design, etc. These should be indicated at this juncture.

Remember that when you are making recommendations you are saying what *should* be done to remedy a situation or to improve something. Look at the example below:

The following recommendations are made:

4.1 (*the correct no*) the feasibility of using perspex *should be* considered;

4.2 the base *should be* attached with super glue instead of screws;

(*Appropriate no e.g. 4*) Recommendations:

It is recommended that :

4.1 (the correct no.) the feasibility of using perspex be considered;

4.2 the base be attached with Superglue instead of screws;

The above use of be by itself is the use of the subjunctive i.e. we use just "be" instead of *should be*.

When you make suggestions you are no longer saying what should be done; you are offering ideas about what could be done.

Suggestions:

1. the base of the sharpener could be extended to give it greater stability;

2. the sharpener could be made in different colours to make it more attractive.

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Suggestions:

1. the base of the sharpener could be extended to give it greater stability;

2. the sharpener could be made in different colours to make it more attractive.

3) Suggesting New Lines of Study

Here you are required to move away from the confines of your own project and tell the reader if the ideas contained in your work could be applied elsewhere, giving rise to new assignments, projects and new areas of study.

EXERCISE: CONCLUSION OF REPORTS:

Look at the content of the two conclusions A and B below taken from a project report and answer the following questions.

1. In what way are they similar?
2. In what way are they different?
3. Study the use of passive voice.
4. What modal verbs are used to give suggestions and recommendations?

Conclusion A :

A robot called RoboMaid **was successfully built** by our team.

The robotic toy could , **however, be further improved** to do other tasks **by** using more sophisticated software and a wider range of programs.

Using the same principle, future projects should undertake the construction of other appliances which could perform more useful tasks than just serving drinks.

Conclusion B :

The Automatic Firewall and Routing Apple OS X server **was successfully completed** by our team. Most of our objectives were met. This project **was also nominated** one of the three outstanding awards of Temasek Polytechnic, School of Engineering Project Show 2000. We were able to build a machine that was able to access 5000 iMacs in a flexible and user-friendly manner. The machine is fully integrated and is easy to operate.

The machine could be further improved in numerous areas. The following changes **have been recommended** :

- 1) Adding memory cards to increase limited RAM space of the controller.
 - 2) Using a G5 microprocessor to control and stabilise the current source during start up.
 - 3) Using discrete digital selector and display to select current level.
- More work has to be done in the following areas :
- 1) The function of the machine could be expanded to access Linux computers.
 - 2) Another UNIX server could be integrated for security purposes.

Read the following conclusion and recommendation and critically analyze it.

This study investigates the impact of the foreign capital inflows and economic growth on stock market capitalization in 18 Asian countries by using the panel data from the period of 2000-2010. The ARDL bound testing co integration approach confirms the valid long run relationship between considered variables. Results indicate that foreign direct investment has significant negative economic growth has significant positive relationship with the stock market capitalization; whereas, the results of workers' remittances is found insignificant in long run. The error correction model confirms the significant positive relationship of economic growth workers' remittances while, FDI has negative and significant impact on stock market capitalization in short run. Results of causality test based on Toda and Yamamoto (1995) show the bidirectional causal relationship of foreign direct investment and direct economic growth with stock market capitalization. However, no causal relationship is found in between workers' remittances and stock market capitalization. It suggested that investor should not idealize the inflow of workers' remittances to invest in Asian stock markets in long run. Simultaneously, size of the economy is a better leading indicator for Asian stock markets. On the other hand, inflows of FDI may mislead the investor to invest. Investor should keep an eye whether FDI come in the competition of domestic market or not? If this happens so investor should not invest in the stock market of host country.

For the given conclusion, write recommendations.

i. Price and quality of food

While it was generally agreed that the price was reasonable and the variety wide, more than half of those surveyed felt that the quality of food should could be improved upon

particularly in the areas of the taste of the food, size of food portions and freshness of ingredients.

ii. Competition

Many canteen users, especially staff, were attracted by a new food court at the new neighborhood shopping centre opposite the polytechnic. Canteen takings were also affected by six newly installed non-carbonated health drinks vending machines located in the canteen. Many staff also found sandwiches from the sandwich bar located outside lecture theatre 4 of DP tasty and healthy. Compounding the problem could be the canteen did not seem to serve enough types of healthy food.

iii. Canteen operating hours

Respondents, majority of whom were staff, were dissatisfied with the canteen operating hours. They wished the canteen to be opened as early as 8 am to cater to those wanted to have breakfast or avoid the lunch crowd.

iv. Ambiance of the canteen

The ambiance of the canteen was not conducive for having meals due to the lack of air conditioning and high noise levels. The music played by the newly installed juke box worsens the situation as the selection of music turns away the adults. Hence, to improve the canteen recommendation must address the problems identified in the above areas.