Research Report

Therapeutic Ultrasound: Clinician Usage and Perception of Efficacy

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Abstract: A mailed questionnaire, employing both open- and closed-ended questions, was distributed to all members of the Australian Physiotherapy Association (South Australian branch) registering an interest in the musculoskeletal field. Questions were asked regarding the usage and perception of the effectiveness of therapeutic ultrasound. A response rate of 55% was achieved, with a total of 210 questionnaires available for statistical analysis. The results demonstrated that ultrasound is frequently used as an electrotherapy modality by South Australian musculoskeletal physiotherapists. Most physiotherapists perceived ultrasound to be effective in treating localized, superficial conditions, especially when used in conjunction with other treatment techniques and at suitable dosages. However, ultrasound was thought to be most effective in producing a placebo effect. These findings suggest that ultrasound is perceived as an effective treatment tool when applied appropriately. Its placebo quality may contribute to its effectiveness. Further scientific research is warranted to confirm the results. Randomized controlled trials investigating ultrasound's usefulness for muscle strains, scar tissue, bursitis and tendinitis are indicated. The results of this study will be useful for educators and researchers, and suggest that more research into ultrasound applied as part of a treatment package is needed.

Key words: ultrasound, efficacy, usage, perceptions of effectiveness

Introduction

Physiotherapists use therapeutic ultrasound at a rate exceeding that of any other electrophysical agent [1–5]. Previous questionnaires have consistently identified ultrasound as the most commonly owned and used electrophysical agent [1–5]. Previous studies were conducted in two Australian states (Victoria and Queensland), Singapore, the UK and the USA. No available data exist for South Australia. Therefore, the first aim of this study was to describe the frequency and pattern of use of therapeutic ultrasound by practising musculoskeletal physiotherapists in South Australia.

While ultrasound is a commonly used clinical modality, there are limited numbers of published scientific studies investigating the efficacy of ultrasound in improving clinical outcomes [4]. Those that exist are of poor quality due to small sample sizes and methodological flaws, compromising their validity and reliability [6, 7]. Sound research must be conducted to allow practice consistent with the current economic climate [8, 9]. Randomized controlled trials (RCTs), although scientifically robust, are known to be time consuming and expensive [10]. Therefore, it is crucial that systematic investigation is performed to identify areas where ultrasound is perceived to be effective before RCTs are conducted [11].

To perceive is defined as to "apprehend with the mind, observe, understand... [to] regard mentally in a specific manner" [12]. Perception can be influenced in many ways, depending on the education, knowledge, motivation, wants, memory, expectations and personality

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of the perceiver [13–15]. As perception is based on past experience, an indication of physiotherapists' perception of ultrasound's effectiveness in treating a variety of pathologies can further direct clinical research into areas where significant outcomes can be achieved. Therefore, the second aim of this study was to describe practising musculoskeletal physiotherapists' perception of the effectiveness of ultrasound as a treatment modality.

Methods

A focus group was conducted using nine subjects to assist with questionnaire construction. Focus groups consisting of participants varying in age, gender and clinical experience as a heterogenous sample are thought to allow consideration of different perspectives, beliefs, knowledge and skills, and to aid discussion [16]. The focus group was gathered for a 60 minute discussion and an independent volunteer was recruited to transcribe the discussion. Open questions were asked by the moderator so that the topic could be explored fully, hypotheses generated and appropriate questions constructed for the survey [17, 18].

Questionnaire items were constructed from analysis of the focus group responses to address the aims of the study. The questionnaire (see Appendix) was compiled to include two sections. Section 1, consisting of 13 items, addressed demographic details such as gender, age, experience, field of work, education, ownership of ultrasound and patient load. Data was collected via closed-ended categorical and yes/no questions. Section 2, consisting of five items, investigated the subjects' usage of ultrasound, their knowledge of appropriate dosages, and their perception of its effectiveness for various conditions. Information in this section was recorded on visual analogue scales.

Before distribution, the survey was pre-tested on a sample of convenience in order to improve the clarity of the questions and instructions, comprehension, format and readability. Potential problems in the interpretation of items were also identified. These procedures, in addition to the focus group discussion, ensured the face and content validity of the questionnaire [19–21]. Criterion-related validity could not be achieved as there were no questionnaires available investigating the use of ultrasound or physiotherapists' perceptions of its effectiveness. One study used visual analogue scales to measure clinicians' perceptions of the efficacy of lasers, but did not assess validity [22]. However, visual analogue scales have previously been established as valid for measures of subjective sensations [23].

The questionnaire was mailed to 380 physiotherapists listed in the musculoskeletal special interest group of the South Australian branch of the Australian Physiotherapy Association (APA). Subjects were excluded from the survey if they were not currently practising physiotherapy and if they were not members of the APA. Overseas, interstate, or student members of the association were not included. No distinctions between full- and part-time or urban and rural physiotherapists were made. Due to confidentiality procedures, the contact details of the physiotherapists fulfilling the inclusion criteria were not released to the researchers. This study was conducted under the approval of the Divisional Ethics Committee (Health Sciences) at the University of South Australia.

The questionnaire was sent out with a cover letter of introduction explaining the purpose of the study and assuring confidentiality. An instruction sheet was also included, along with a stamped, self-addressed envelope. Subjects were requested to complete the survey and return it within 10 days. Completion of the questionnaire was considered as consent to use the information gathered.

Focus group data were analysed in terms of trends and common ideas. Results from the questionnaire were entered into a Microsoft Excel spreadsheet. A number of levels of measurement were used, including categorical (such as gender), ratio (such as age), and ordinal (in the form of visual analogue scales). Responses were coded into numerical format. Summary statistics were provided in the form of percentages for each question, and means and standard deviations (SDs) where appropriate. Results are displayed in graphs and tables.

Results

Two hundred and ten questionnaires were completed and returned, a response rate of 55%. One of these was excluded due to incomplete data. Of the respondents, 131 (63%) were female and 78 (37%) were male. The age of respondents ranged from 22 to 61 years, with a mean ± SD of 37.4 ± 9.8 years. The average length of experience was 14.6 ± 9.25 years. Most respondents (91%) had completed their undergraduate training in South Australia. Most worked in private practice (70.3%). Only 10.5% of participants had attended continuing education in electrophysical agents in the past 5 years. Of respondents, 98% possessed at least one ultrasound machine in their place of work.

To accommodate part-time physiotherapists, the frequency of ultrasound usage was calculated in relation to the number of patients treated. Half of physiotherapists used ultrasound in less than 30% of treatment sessions. An average of 32 ± 22% of treatment sessions involved ultrasound and 70% of respondents used ultrasound at least once a day.

Respondents were asked to identify the four most frequently used modalities. The most frequently used modality was continuous ultrasound, with 91

physiotherapists (48%, n = 191) ranking this modality as their first choice (Figure).

Respondents were permitted to select the two main factors influencing their choice to use ultrasound. Most respondents chose ultrasound because of its tissue healing and thermal properties (Table 1).

Respondents were asked to complete a visual analogue scale indicating their perception of the effectiveness of ultrasound for a variety of clinical conditions. The list of conditions presented in this questionnaire was obtained from physiotherapy populations in Denmark and the UK [24, 25]. Therapeutic ultrasound was perceived to be most effective for chronic muscle tears, chronic scar tissue, acute bursitis and tendinitis, as well as for creating a placebo effect (visual analogue scores > 50) (Table 2).

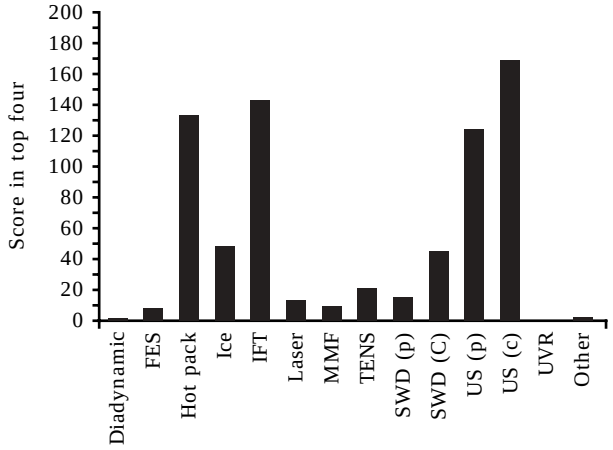

Figure. Usage of different electrophysical agent modalities.

FES = functional electrical stimulation; IFT = interferential; MMF = modulated medium frequency; TENS = transcutaneous electrical nerve stimulation; SWD (p) = shortwave diathermy pulsed; SWD (c) = shortwave diathermy continuous; US (p) = ultrasound pulsed; US (c) = ultrasound continuous; UVR = ultraviolet radiation.

Table 1. Factors influencing physiotherapists' decision to use ultrasound (n = 206)

Factor	n (%)
Tissue healing	173 (84.0)
Thermal properties	155 (75.2)
Placebo	22 (10.7)
Gives opportunity to talk to the patient	9 (4.4)
Patient asks for it	11 (5.3)
Diagnosis, e.g. of stress fractures	10 (4.9)
You own a machine	1 (0.5)
It is portable and easy to use	8 (3.9)
To fill in treatment time	1 (0.5)
Other	16 (7.8)

Higher perceived effectiveness scores were reported by physiotherapists using ultrasound in more than half of their treatment sessions than by the entire physiotherapy population (Table 3). This indicates that therapists using ultrasound more frequently found it to be most effective.

Most respondents (90.7%) reported that ultrasound was most effective when used in combination with other techniques. Participants were requested to select two therapies they considered most useful when applied together with ultrasound. Passive mobilization, massage and stretches were thought to be most effective in conjunction with ultrasound (Table 4).

Respondents' knowledge was assessed by requesting them to indicate the most appropriate dosages for an acute and a chronic condition. Using guidelines from Low and Reed [26], subjects were given a knowledge

Table 2. Physiotherapists' perceptions of ultrasound's effectiveness for various conditions (score /100)

	Visual analogue scale score, mean (± SD)
Acute ankle sprain	35.3 (± 26.7)
Chronic knee OA	39.0 (± 26.0)
Chronic muscle strain	54.2 (± 28.7)
Chronic scar tissue	57.2 (± 27.3)
Cervical spondylosis	42.0 (± 27.8)
Acute tendinitis	54.2 (± 28.6)
Chronic lumbar disc	22.2 (± 21.7)
Acute bursitis	52.4 (± 23.2)
Placebo effect	61.3 (± 23.0)

SD = standard deviation; OA = osteoarthritis.

Table 3. The influence of usage on the perceived effectiveness of US (average score /10)

Condition	Entire population (n = 26)	Those using US in more than half of treatments (n = 37)
Acute ankle sprain	3.53	4.54
Chronic knee OA	3.95	5.2
Chronic muscle strain	5.42	6.35
Chronic scar tissue	5.72	6.44
Cervical spondylosis	4.2	5.46
Acute tendinitis	5.42	6.4
Chronic lumbar disc	2.22	3.12
Acute bursitis	5.24	5.83
Placebo effect	6.13	6.33

US = ultrasound; OA = osteoarthritis.

Table 4. Techniques perceived to be effective when combined with ultrasound

Techniques	Number of responses (respondents could choose two)
Diadynamic	1
Exercises	49
Hot pack	2
Ice	2
Interferential	15
Manipulation	30
Massage	82
Modulated medium frequency	0
Passive mobilization	129
Shortwave diathermy	2
Stretches	48
Traction	1
Other	6

score based on the most appropriate answers. The perception of the efficacy of ultrasound held by participants who achieved 100% of the total knowledge score was compared with the perception of subjects who scored less than 25%. Table 5 demonstrates that for each condition, respondents with knowledge of appropriate dosages reported a higher perceived effectiveness score than did respondents using ultrasound with less appropriate knowledge of dosage.

Discussion

Ultrasound was the most commonly used electrophysical agent among respondents to the questionnaire (South Australian musculoskeletal physiotherapists). This is similar to findings in the UK, USA, and Brisbane, Australia [1–5]. Ultrasound was used more often by South Australian physiotherapists (32% of treatment sessions) than by private practitioners in the UK (20%) [25]. However, physiotherapists in the UK's National Health Service (public) used ultrasound in more treatment sessions (54%) [25]. The population surveyed in the present study consisted of both private and public practitioners. This may account for the difference in frequency of ultrasound use in the current sample compared to that reported by ter Haar et al [25]. The present study calculated frequency of use as a proportion of the number of patients treated in a week, not the number of treatment sessions. It is possible that physiotherapists see some patients more than once a week and, hence, this is not a valid measure of the number of treatment sessions per week. If this is the case, the value for the number of weekly treatment sessions is artificially low. This will cause the overall proportion of ultrasound usage to be higher than its true value. Hence, it is likely that ultrasound is used in less than 32% of treatment sessions by practising musculoskeletal physiotherapists in South Australia. Alternatively, the total number of times that ultrasound is used in a week could be used.

Most surveys present ultrasound usage frequency by quantifying the number of physiotherapists using the modality once a day. The data collected in the present survey allowed calculation of this for the South Australian population; 70% used ultrasound at least once a day. This figure is comparable with other studies [3–5, 27].

No published studies have investigated the perception of physiotherapists regarding the effectiveness of ultrasound for various conditions. There was wide variation in the results received, as indicated by the high SDs for the visual analogue scale scores. Participants in this questionnaire considered that ultrasound was most effective for conditions such as chronic muscle strains,

Table 5. Effect of knowledge on perception of effectiveness of ultrasound (average score /10)

Condition	Respondents with 100% for knowledge criteria	Respondents with less than 25% for knowledge criteria
Acute ankle sprain	3.97	1.23
Chronic knee OA	3.86	1.54
Chronic muscle strain	5.23	3.98
Chronic scar tissue	5.68	4.54
Cervical spondylosis	3.91	2
Acute tendinitis	5.94	3.15
Chronic lumbar disc	2.1	1.33
Acute bursitis	5.56	3.16
Placebo effect	6.1	5.51

OA = osteoarthritis.

chronic scar tissue, acute bursitis and acute tendonitis, as well as for providing a placebo effect. The perception was that this effect was due to its tissue healing and thermal properties.

Musculoskeletal physiotherapists in South Australia use ultrasound frequently. In conformity with the evidence-based practice paradigm, treatment decisions should be supported by the best scientific evidence of effectiveness [9]. However, there is little available evidence to support the efficacy of therapeutic ultrasound [25, 27].

As the current survey canvassed the total population and achieved a reasonable response rate (55%), the results can be considered to reflect South Australian musculoskeletal physiotherapists' perception of the efficacy of ultrasound. The descriptive data, or professional perception, obtained from this study is a form of scientific evidence, even though it ranks low in the hierarchy of scientific evidence. Hence, this study provides evidence that ultrasound is perceived to be effective by South Australian musculoskeletal physiotherapists in the treatment of conditions such as chronic muscle sprains and scar tissue. The modality is perceived to be most effective when used as an adjunct to the physiotherapy treatment package.

Respondents with a higher overall knowledge score reported a higher perception of ultrasound's effectiveness for every listed condition. It is possible that these respondents have a keener interest in ultrasound and this may positively influence their perception. Alternatively, respondents with superior knowledge regarding optimum dosages of ultrasound for various conditions may be more likely to apply appropriate dosages and procure better treatment outcomes.

The study has a few limitations. First, the fact that the level of evidence gained from this study ranks low on the evidence-based ranking scales is a limitation. However, the information gained should be useful to researchers who are considering more scientific evidence, such as RCTs, regarding the efficacy of ultrasound as a treatment technique. In particular, the combination of ultrasound with other treatments should be researched rather than ultrasound in isolation, as is usually the case. The information should also be useful to educators, who can use this form of practitioner-based evidence, in addition to the evidence from RCTs, in their teaching of ultrasound. Second, the validity of studies aiming to describe the perception of a self-selecting sample may be confounded by response bias. It is possible that only physiotherapists with a strong favourable or unfavourable perception of ultrasound's effectiveness were motivated to complete the questionnaire. Similarly, only physiotherapists who felt they had sufficient exposure to ultrasound to make a judgement regarding its effectiveness may have returned the survey. Third, the subjects were members of the musculoskeletal special interest group, which does not necessarily mean that they were practising musculoskeletal physiotherapists. In hindsight, a question should have been asked to determine whether participants were currently practising physiotherapists. These factors must be considered when attempting to generalize the results gained, particularly as the usage and perception of the musculoskeletal physiotherapy population may differ from the perceptions of physiotherapists working in other fields.

Conclusions

Musculoskeletal physiotherapists in South Australia who responded to the questionnaire used ultrasound most frequently of all electrophysical agents. Rates of ultrasound usage among respondents were consistent with those reported in other populations.

Physiotherapists working in the musculoskeletal field in South Australia perceived ultrasound to be most effective in creating a placebo effect. However, perception of therapeutic effectiveness was also considered high for chronic scar tissue, chronic muscle strains, acute tendinitis and acute bursitis. Ultrasound was perceived to be most effective when applied in conjunction with other physiotherapy techniques, specifically passive mobilization and massage.

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Appendix – Questionnaire on the Use and Effectiveness of Therapeutic Ultrasound

Section 1: DEMOGRAPHIC DETAILS

1. What is your **gender?** TICK ONE.
Male ..... ☐ 1
Female ..... ☐ 2

2. What is your **date of birth**? ..... ☐☐ / ☐☐ / ☐☐☐☐
day / month / year

3. In what year did you first **begin** working as a physiotherapist? ..... ☐☐☐☐

4. Since you began working as a physiotherapist, have there been any periods during which you **have not** practised? TICK ONE.
Yes ..... ☐ 1
No ..... ☐ 2

If YES, for what time in total have you been non-practising?
INDICATE IN YEARS (y) AND MONTHS(m) ..... ____y
..... ____m

5. Where did you receive your **undergraduate training**? TICK ONE.
South Australia ..... ☐ 1
Victoria ..... ☐ 2
New South Wales ..... ☐ 3
Western Australia ..... ☐ 4
Queensland ..... ☐ 5
Other – please specify_____

6. Where do you work? TICK ONE.
Metropolitan (population > 100,000) ..... ☐ 1
Provincial (population 25,000–99,999, e.g. Whyalla) ..... ☐ 2
Rural (population < 25,000) ..... ☐ 3

7. Which best describes your **current field of work?** TICK ONE.

- Sports ☐ 1
- Paediatrics ☐ 2
- Geriatrics ☐ 3
- Women's health ☐ 4
- Occupational health and safety ☐ 5
- Orthopaedic inpatients ☐ 6
- General practice ☐ 7
- Community health care ☐ 8
- Other – please specify ☐ 9

8. Which best describes your **current place of employment**?
If more than one, TICK WHERE YOU HAVE THE MOST HOURS.

- Public Hospital ☐ 1
- Private Hospital ☐ 2
- Public Organisation ☐ 3
- Private Practice ☐ 4
- Other – please specify ☐ 5

9. Have you completed any **postgraduate education**? TICK ONE.

- Yes ☐ 1
- No ☐ 2

If YES, please specify

Title	University	Year of completion
1.		
2.		
3.		

10. Have you attended any **courses** concerning **electrotherapy** in the **last 5 years**? TICK ONE.

- Yes ☐ 1
- No ☐ 2

If YES, how many? _____

11. Rank the following electrotherapy modalities according to how often you used them in your clinical practice during the year 1999. If you were not practising in 1999, go to question 12.
Rank the most used modality [1], the next [2], etc. If you never use a modality, write [NA].

Ranking

- Diadynamic ☐ 1
- Functional electrical stimulation ☐ 2
- Hot packs ☐ 3
- Ice ☐ 4
- Interferential therapy ☐ 5
- Laser ☐ 6
- Modulated medium frequency ☐ 7
- Transcutaneous Electrical Neuromuscular Stimulation ☐ 8
- Shortwave diathermy (pulsed) ☐ 9
- Shortwave diathermy (continuous) ☐ 10
- Ultrasound (pulsed) ☐ 11
- Ultrasound (continuous) ☐ 12
- Ultraviolet ☐ 13
- Other – please specify _____ 14

12. Does your department/practice **own** an **ultrasound machine**? TICK ONE.

Yes ..... ☐ 1
No ..... ☐ 2

If YES, please specify – How many_____
– Brand(s)_____
– Age(s)_____(years)

13. Which best describes **how many** patients you would treat per **week**? TICK ONE.

10 or less ..... ☐ 1
11 – 20 ..... ☐ 2
21 – 30 ..... ☐ 3
31 – 40 ..... ☐ 4
41 – 50 ..... ☐ 5
51 – 60 ..... ☐ 6
61 – 70 ..... ☐ 7
71 – 80 ..... ☐ 8
81 – 90 ..... ☐ 9
91 or more ..... ☐ 10

Section 2: USAGE OF ULTRASOUND

1. How many times per **week** would you use **ultrasound** to treat patients? TICK ONE.

5 or less ..... ☐ 1
6 – 10 ..... ☐ 2
11 – 15 ..... ☐ 3
16 – 20 ..... ☐ 4
21 – 25 ..... ☐ 5
26 – 30 ..... ☐ 6
31 – 35 ..... ☐ 7
36 or more ..... ☐ 8

2. Consider the following examples:
(i) An **acute day one lateral collateral ligament** of the **ankle** sprain.

Which **modes of ultrasound** would be **most** appropriate for this condition on **day 1**?
INDICATE BELOW.

a) Continuous ..... ☐ 1 OR Pulsed ..... ☐ 1
b) 3 MHz ..... ☐ 2 OR 1.5 MHz ..... ☐ 2
c) < 1 watt/cm^2 ..... ☐ 3 OR > 1 watt/cm^2 ..... ☐ 3

What is your **perception** of the **effectiveness** of **ultrasound** in **treating** this **condition** on **day 1**?
PLEASE ANSWER BY PLACING A **MARK** AT THE APPROPRIATE POSITION ON THE FOLLOWING SCALE.

|———————————————————————|

Not effective Extremely effective

Comments: _____

_____

_____

(ii) Chronic medial compartment osteoarthritis of the **knee**.

Which **modes of ultrasound** would be **most** appropriate for this condition in its **chronic stage**? INDICATE BELOW.

a) Continuous ..... ☐ 1 OR Pulsed ..... ☐ 1
b) 3 MHz ..... ☐ 2 OR 1.5 MHz ..... ☐ 2
c) < 1 watt/cm^2 ..... ☐ 3 OR > 1 watt/cm^2 ..... ☐ 3

What is your **perception** of the **effectiveness** of **ultrasound** in **treating** this **condition** in its **chronic stage**? PLEASE ANSWER BY PLACING A **MARK** AT THE APPROPRIATE POSITION ON THE FOLLOWING SCALE.

Not effective — Extremely effective

Comments: _____

_____

3. What is your **perception** of the **effectiveness** of **ultrasound** in **treating** the following **conditions**. PLEASE ANSWER BY PLACING A **MARK** AT THE APPROPRIATE POSITIONS ON THE FOLLOWING SCALES.

a) Chronic muscle strains

Not effective — Extremely effective

b) Chronic scar tissue

Not effective — Extremely effective

c) Cervical spondylosis

Not effective — Extremely effective

d) Acute tendinitis

Not effective — Extremely effective

e) Chronic lumbar disc derangement

Not effective — Extremely effective

f) Acute bursitis

Not effective — Extremely effective

g) Do you think ultrasound is effective as a placebo?

Not effective — Extremely effective

4. When you use ultrasound, which **2 main factors** influence your decision to use it? TICK **2** OF THE FOLLOWING.

Tissue healing properties	☐ 1
Thermal properties	☐ 2
Placebo	☐ 3
Gives opportunity to talk to patients	☐ 4
Patients ask for it	☐ 5
To diagnose certain conditions (e.g. stress fractures)	☐ 6
You own a machine	☐ 7
It's portable and easy to apply	☐ 8
To fill in treatment time	☐ 9
Other – please specify _____	10

5. PLEASE **TICK** THE RELEVANT BOX.

Generally, in the treatment of conditions, do you find ultrasound is:

ineffective	☐ 1
more effective if used in **isolation**	☐ 2
more effective if used together with **other techniques**	☐ 3

If you feel ultrasound is more effective when used together with other techniques, please specify which **2 techniques** you find the **most effective** when combined **with ultrasound**:

Diadynamic	☐ 1
Exercise	☐ 2
Hot packs	☐ 3
Ice	☐ 4
Interferential therapy	☐ 5
Manipulation	☐ 6
Massage	☐ 7
Modulated medium frequency	☐ 8
Passive mobilization	☐ 9
Shortwave diathermy	☐ 10
Stretches	☐ 11
Traction	☐ 12
Other – please specify _____	13

Thank you for completing this survey.

If you have any additional comments regarding ultrasound and why you do or do not use it, please feel free to write them in the space below.

_____

_____

_____