

# **A Call to Action Towards an Evidence-Based Approach to using Verbal Encouragement during Maximal Exercise Testing**

**Running title:** Verbal encouragement during maximal exercise testing

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## Summary

By definition, maximal exercise testing inherently requires participants to give a maximal effort. This is an important practical issue as submaximal efforts can produce invalid test results. Verbal encouragement is commonly used to motivate participants to maintain or increase effort investment during maximal exercise testing. Accordingly, studies have reported significant increases in time to exhaustion of between 8% and 18% during  $\dot{V}O_{2\max}$  and multistage shuttle run tests, and a significant 30.5 m mean increase in 6-min walk test distance. Significant improvements during shorter tests, such as the Wingate and 2-min walk tests, have not been observed however. Although participants typically perceive verbal encouragement positively during maximal exercise testing, around one-third have neutral or negative perceptions. Despite the ubiquity and importance of verbal encouragement during maximal exercise testing, surprisingly little research has investigated the characteristics of effective encouragement with respect to its content, timing, and frequency. The only randomised controlled trial to investigate one of these issues observed that verbal encouragement delivered every 20 s increased time to exhaustion during  $\dot{V}O_{2\max}$  testing, but not every 60 s or 180 s. Of particular concern is that several exercise testing guidelines have incorporated specific guidelines for the use of verbal encouragement, but not provided any theoretical or empirical justification, presumably because of the limited research to inform practice. Recent empirical research does provide some important insight into participant preference for the content and timing of verbal encouragement during maximal exercise testing, however, much more research is clearly required to establish comprehensive evidence-based guidelines.

## Introduction

Maximal exercise testing is commonly undertaken in exercise physiology laboratories with clinical and non-clinical populations. Test results can be used to determine physical and physiological capacities to investigate causes of unexplained exercise intolerance, help identify certain non-communicable diseases, and form the basis of exercise programmes and subsequently evaluate their efficacy (ATS/ACCP, 2003). An important feature of maximal exercise tests is a requirement for the participant to provide a maximal effort, as submaximal efforts can invalidate test results (Chitwood *et al.*, 1997). Verbal encouragement is commonly used to motivate individuals to enhance commitment to effort investment during maximal exercise testing (Halperin *et al.*, 2015), and is recommended in several exercise testing guidelines (ATS/ACCP, 2003; ACSM, 2014; ATS, 2002). In ‘open loop’ tests such as the  $\dot{V}O_{2\max}$  test, increased effort would result in improvements in such variables as time to exhaustion and maximal power output, which are useful for exercise programming (Midgley & McNaughton, 2006). Concomitant increases in maximal physiological responses such as oxygen uptake and heart rate also are likely (ATS/ACCP, 2003), however, this might not be evident where a physiological plateau is observed (Midgley *et al.*, 2007). It is also possible that submaximal responses could be affected by verbal encouragement, for example, via alterations in neurohormonal stimulation (Konishi *et al.*, 2013). Considering its ubiquity and practical importance, it is surprising that there has been limited research investigating the efficacy of verbal encouragement during different types of maximal exercise tests. Even less research has been conducted to identify characteristics that define effective verbal encouragement in terms of content, tone, loudness, timing, and frequency of delivery. Of particular concern is that despite the recognised importance of evidence-based practice in the exercise sciences (Amonette *et al.*, 2010), the only verbal encouragement guidelines that provide specific details of what should be said and when during maximal exercise testing (ATS, 2002) are not supported by any empirical justification.

The following includes a critique of studies that investigated the efficacy of verbal encouragement for improving performance during ‘whole body’ maximal exercise testing and a brief discussion of its psychological basis. A discussion of what might constitute characteristics of effective verbal encouragement is also included, along with recommendations where theoretical or empirical justifications exist. A review of studies investigating the use of verbal encouragement during strength testing is beyond the scope of the present paper, and interested readers are directed to the specific papers related to these studies (Rube & Secher, 1981, Johansson *et al.*, 1983; McNair *et*

*al.*, 1996; Desrosiers *et al.*, 1998; Kimura *et al.*, 1999; Campenella *et al.*, 2000; Jung & Hallbeck, 2004; Amagliani *et al.*, 2010; Binboğa *et al.*, 2013).

## **Empirical Evidence**

### ***Efficacy***

Studies investigating the efficacy of verbal encouragement for improving performance during various maximal exercise tests are shown in Table I. These studies evidence that verbal encouragement can have profound effects on maximal exercise test performance, with significant mean increases in time to exhaustion of between 8% and 18% during  $\dot{V}O_{2\max}$  and multistage shuttle run tests (Andreacci *et al.*, 2002; Chitwood *et al.*, 1997; Moffatt *et al.*, 1994; Neto *et al.*, 2015), and a significant 30.5 m mean increase in 6-min walk test distance (Guyatt *et al.*, 1984). Increases in  $\dot{V}O_{2\max}$  test duration with verbal encouragement also have been found to translate into improvements in important physiological measures, such as  $\dot{V}O_{2\max}$  and maximal heart rate (Andreacci *et al.*, 2002; Chitwood *et al.*, 1997; Moffatt *et al.*, 1984). These improvements are consistent with the observation that most participants perceive verbal encouragement as helpful in motivating them to invest effort during maximal exercise testing (Midgley *et al.*, in press). Performance improvements have not been a consistent finding, however, since verbal encouragement tended to improve performance only in the longer duration tests. Another plausible explanation for the inconsistent findings is differences in the effectiveness of the content, timing, and frequency of the verbal encouragement that was used, although this is difficult to evaluate since these details were mostly either not reported or only limited details were provided.

The efficacy of verbal encouragement for improving maximal exercise test performance has been found to be somewhat dependent on personality traits. Chitwood *et al.* (1997) reported verbal encouragement significantly increased mean  $\dot{V}O_{2\max}$  test duration by 16% in individuals classified as Type B scorers, compared to a non-significant 1% increase in Type A scorers. Type A scorers are characterised by extremes of competitiveness, time urgency, and aggressiveness, whereas Type B scorers are characterised by the relative absence of Type A characteristics (Carver *et al.*, 1976). Similar personality effects were reported by Binboğa *et al.* (2013) for plantar flexion maximal voluntary contraction force, where verbal encouragement significantly improved performance in a low conscientiousness group, but not in a high conscientiousness group. Further insight into this issue comes from recent findings that around one-third of participants reported either a neutral or negative perception of verbal

encouragement during  $\dot{V}O_{2\max}$  testing (Midgley *et al.*, in press). Of particular note is that the participants with a negative perception reported that encouragement was annoying or distracting. What the verbal encouragement distracted these participants from was not explored in-depth in this quantitative study, however, one participant stated the encouragement was putting him off focusing. The authors suggested that the encouragement could interfere with attentional focus strategies that some participants employ during exercise (Baghurst *et al.*, 2004), although further research is needed to further investigate this possibility. The negative perception of verbal encouragement in some individuals does raise an important issue, in that the encouragement could have a negative impact on maximal exercise test performance. Halperin *et al.* (2015) suggested that establishing personality type might be useful for deciding the appropriateness of providing verbal encouragement to specific individuals during exercise testing. Given the current limited research to inform such practice, an alternative might be to simply ask participants before the test whether they would like to be verbally encouraged. During the informed consent process would be an appropriate opportunity. Before investing effort into establishing informed guidelines to address this issue, however, it would be useful for future research to investigate whether verbal encouragement negatively impacts on actual test performance of some individuals with extreme personality types. Until such research suggests otherwise, it is recommended that verbal encouragement is given to all participants during maximal exercise testing.

### ***Frequency, Timing and Content***

The frequency of verbal encouragement has been found to directly influence its efficacy during maximal exercise testing. Andreacci *et al.* (2002) observed that verbal encouragement was effective in increasing treadmill run time during  $\dot{V}O_{2\max}$  testing when it was delivered every 20 s throughout the test, but not when delivered every 60 s or 180 s. The timing of verbal encouragement also has been found to be important. In a study investigating participants' perceptions of verbal encouragement during  $\dot{V}O_{2\max}$  testing, some participants perceived the encouragement as equally useful throughout the test (Midgley *et al.*, in press). More often, however, participants stated the encouragement was only useful or more useful later in the test when they were feeling tired and thinking about terminating the test. Overall, these findings suggest frequent encouragement is important, but the encouragement should be restricted to the most physically and psychologically demanding parts of the test. This strategy also would reduce exposure time of participants with a negative perception of the encouragement. If ratings of perceived exertion are being recorded during the exercise test, a value of 16 (between 'hard' and 'very hard'; Borg, 1982) might be a good marker to start encouragement, otherwise audible signals of respiratory

distress might be a useful practical cue. For shorter maximal tests, such as a Wingate test, it would be expected that constant verbal encouragement would be preferred. The current limited evidence does not support this premise, however, and further research is required to investigate the influence of test duration on optimising the timing of verbal encouragement delivery.

What constitutes effective verbal encouragement with respect to what is said is currently unknown; however, a recent study provides some insight into this issue (Midgley *et al.*, in press). Participants were asked if there were any particular verbal encouragement phrases they found useful for motivating them to invest effort during a  $\dot{V}O_{2\max}$  test. Of the participants who reported a positive perception of the encouragement, some had no preference and reported all encouragement as useful, but most identified specific phrases. These phrases were categorised into general encouragement, "keep going"; use of power words, "keep pumping those arms and legs"; reference to maximum, "keep going to max"; and positive reinforcement, "you're doing really well". This substantial inter-individual variation in the preference for the content of verbal encouragement highlights the complex task of establishing evidence-based guidelines. Self-talk is used by most people during exercise (Gammage *et al.*, 2001; van Raalte *et al.*, 2015) and can provide further insight into what might constitute effective verbal encouragement during maximal exercise testing. Single cue words, short phrases, and full sentences are all used during self-talk, but short phrases are used much more frequently. Similarly, out of the motivational aspects of self-talk categorised as mastery, arousal, and drive, the latter was most frequently used. These findings suggest that short phrases to increase drive, such as 'keep it going' and 'keeping driving to your max', should dominate verbal encouragement. An alternative plausible viewpoint is that optimal verbal encouragement would require the encouragement to be delivered throughout the test, but different categories of phrases being delivered at different points during the time course of the test.

Johansson *et al.* (1983) reported that increasing the loudness of encouragement from 66 to 88 dB during isometric contractions of the triceps brachii muscle increased force by 8%; however, no studies have investigated variations in loudness of verbal encouragement during 'whole body' maximal exercise testing. Of note, two participants in a recent study stated that the tone of voice during verbal encouragement was most important (Midgley *et al.*, in press). Lastly, simultaneous hand clapping has been used with verbal encouragement during maximal exercise testing (Andreacci *et al.*, 2002); however, the efficacy of this strategy compared to verbal encouragement alone has not been established. Future research should therefore investigate the effects of variations in the loudness and tone of verbal encouragement, as well as the addition of hand clapping.

## ***Standardisation***

Verbal encouragement has been recognised as a potential confounder in experimental research (Guyatt *et al.*, 1984; Halperin *et al.*, 2015) and sports science support (Mahoney, 2007) if not standardised. Standardisation of encouragement in within-subject research designs should reduce confounding, especially where there is potential for experimenter expectancy bias. Standardisation also should increase test-retest reliability in non-research contexts. For between-subjects research designs standardisation might not be effective, however, considering the encouragement might have different effects on the performance of individuals with different personality types. Furthermore, a high level of standardisation in the loudness and tone of verbal encouragement would be extremely difficult to achieve without using pre-recorded encouragement. Although studies reported that pre-recorded verbal encouragement was either effective in significantly increasing maximal voluntary contraction force (Binboğa *et al.*, 2013; Johansson *et al.*, 1983), or had no significant effect (Kimura *et al.*, 1999), no studies have investigated the efficacy of pre-recorded encouragement during ‘whole body’ maximal exercise testing. It would be useful to investigate whether pre-recorded encouragement significantly improves test performance, as well as compare its relative efficacy to ‘live’ encouragement, to establish its utility in improving internal validity.

## **Psychological Basis**

Like the self-talk literature (Hardy, 2006), the verbal encouragement literature can be criticised for its lack of theory-based research and account for much of our lack of understanding of its application. Since the primary purpose of verbal encouragement during maximal exercise testing is to motivate participants to give a maximal effort during the test, a good place to start addressing this issue might be to define a maximal effort. In accordance with Brehm’s motivational intensity theory (Brehm & Self, 1989), potential motivation is the upper limit of effort that a person is willing to exert to satisfy a motive and can be considered equivalent to the term ‘maximal effort’. Motivational intensity is the actual effort at any given time and is expected to change during a maximal exercise test in relation to exercise intensity and duration (Brehm & Self, 1989). Thus the main purpose of verbal encouragement during maximal exercise testing should be to motivate participants to minimise the difference between potential motivation and motivational intensity at the end of the test. Limited empirical research suggests that verbal encouragement does increase effort investment during maximal exercise testing, evidenced by significantly higher maximal ratings of perceived exertion (RPE) (Andreacci *et al.*, 2002). A reduction in submaximal RPE also have been found, which delayed the attainment of maximal RPE and increased time to exhaustion of untrained individuals (Moffatt *et al.*, 1994). An unusual finding, however, is that submaximal RPE

was not reduced by verbal encouragement in competitive runners despite an 18% increase in time to exhaustion (Moffatt *et al.*, 1994). Maximal RPE was not reported so it is difficult to interpret these findings; however, it is plausible that other factors help explain the mechanistic basis for the effects of verbal encouragement on exercise tolerance and that these mechanisms are different for trained versus untrained individuals. Other potential mechanisms include improvements in affect (Hall *et al.*, 2002) and alterations in motor unit activation (Ferguson *et al.*, 2016).

It has recently been recognised that movement efficiency and effectiveness is supported in environmental conditions where appropriate attentional and motivational characteristics are verbally promoted (e.g., see Wulf & Lewthwaite, 2016). These include enhancing expectancies, supporting autonomy, and directing attention externally to movement outcomes, which clearly can be promoted using verbal encouragement. In running tasks, for example, movement efficiency, oxygen consumption and perceptions of effort are improved when runners are verbally provided with in-task favourable feedback (e.g., Stoate *et al.*, 2012), and when attention is verbally directed externally (e.g., Schücker *et al.*, 2013). According to Deci and Ryan (2008) autonomy-supportive motivational climates facilitate intrinsic motivation through satisfying 1) *autonomy*: agency in determining one's own behaviour; 2) *competence*: need to feel competent and capable; and 3) *relatedness*: having bonded interpersonal relationships. In contrast, controlling motivational climates facilitate amotivation and induce stress (Reeve & Tseng, 2011). Ryan and Deci (2008) specify that in autonomy-supportive climates, motivation and subsequent performance will be maximised, however, controlling non-supportive climates can diminish motivation and impair performance. It is proposed that enhancing perceptions of autonomy, competence, and capability support self-efficacy for the task being undertaken, which is critical to the effective direction of motivation.

The constrained action hypothesis explains the benefits of directing attention externally to movement effects (Wulf *et al.*, 2001). Internally focused conscious movement control constrains the motor system by interfering with automatic control processes, whereas an external focus facilitates movement efficiency through support of automatic, unconscious, and reflexive control processes. To optimise maximal effort, verbal encouragement should create an adaptive motivational climate during maximal testing by enhancing performance expectancies (competence), supporting autonomy (control), and avoiding controlled or coercive motivation. Directing attention externally, or avoiding reference to bodily movement and sensations, also should be promoted. These theoretical positions suggest that tailoring verbal encouragement and feedback during maximal testing in this way, should

support optimal performance through enhanced motivation, task self-efficacy, and movement efficiency. The fact that some studies did not observe enhanced performance with verbal encouragement may well be a result of not satisfying, or may well have thwarted, these motivational and attentional principles. To support the development of evidence-based verbal encouragement guidelines, further research needs to explore the content of motivational climates in maximal testing environments and associated performance-related outcomes.

### **Towards an Evidence-Based Approach to Using Verbal Encouragement during Maximal Exercise Testing**

To our knowledge, the only guidelines detailing what verbal encouragement should be given and when during maximal exercise testing, are those published by the American Thoracic Society for the 6 min walk test (ATS, 2002). There was no attempt to support these guidelines with any theoretical or empirical justification, however, and the only study to evaluate their efficacy observed no significant improvements in test performance (Marinho *et al.*, 2014). The authors stated that “We have reason to believe that the use of standardised phrases, issued without intonation and evenly, was not enough to stimulate the elderly, whether or not they had COPD” (p. 542). Clearly much more research is required so that comprehensive evidence-based verbal encouragement guidelines can be written with respect to content, tone, loudness, timing, and frequency, and whether simultaneous hand clapping should be incorporated. Guidelines also should provide direction on whether verbal encouragement should be avoided in people with certain personality types, and whether the characteristics of the encouragement need to be modified for different groups such as athletes, children, and clinical populations. Whether guidelines should differ for maximal exercise test protocols with notably different durations also should be investigated.

We encourage research to be undertaken that is needed for the development of comprehensive evidence-based verbal encouragement guidelines. Only one study examining the efficacy of verbal encouragement during maximal exercise test performance has specified exactly what was said as part of the encouragement, by referring the reader to the guidelines for the 6 min walk test (Marinho *et al.*, 2014). Other studies provided examples (Andreacci *et al.*, 2002; Bullinger *et al.*, 2012; Guyatt *et al.*, 1984; Neto *et al.*, 2015), or no description (Chitwood *et al.*, 1997; Moffatt *et al.*, 1994) of the encouraging words or phrases. So that future research can compare the relative efficacy of different content, tone, loudness, timing, and frequency of verbal encouragement, we also recommend that such research describes details of the encouragement in full.

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## Conflicts of interest

The authors declare that they have no conflicts of interest.

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**Table I.** Summary of studies investigating the effects of verbal encouragement (VE) on physical performance outcomes during maximal exercise testing.

Reference	Participants	Exercise test	Encouragement used	Findings
Guyatt <i>et al.</i> , 1984	43 respiratory and cardiac patients	2-min and 6-min walk tests	Every 30 s. Predetermined statements such as “You’re doing well” and “Keep up the good work”	Significant 30.5 m increase in 6-min walk test and similar but non-significant trend in 2-min walk test
Moffatt <i>et al.</i> , 1994	14 competitive runners and 14 untrained individuals	Treadmill $\dot{V}O_{2\max}$ test	Not stated	Significant 18.0% increase in treadmill run time in competitive runners and 15.3% in untrained individuals
Chitwood <i>et al.</i> , 1997	26 university students: 14 Type A scorers and 12 Type B scorers	Treadmill $\dot{V}O_{2\max}$ test	Statements read from script with consistent voice intonation, inflection, and enthusiasm	Significant 15.7% increase in exercise time in Type B scorers, but no difference in Type A scorers
Andreacci <i>et al.</i> , 2002	28 university students	Treadmill $\dot{V}O_{2\max}$ test	Included “Way to go!”, “Come on!”, “Good job!”, Excellent!”, “Come on, push it!”, “Keep it up!”, “Push it!, and “Let’s go!”. Read from script and volume monitored using sound meter	Significant 8.1% increase in exercise time when VE was given every 20 s, but no significant difference when given every 60 s or 300 s.
Bullinger <i>et al.</i> , 2012	10 athletes and 9 non-athletes	Wingate test	Personalised using participants name and positive (e.g. “Go, go, go”, “You can do it”, and “Push through it”)	No significant main effect for encouragement, nor any interaction effect with athletic vs. non-athletic group
Marinho <i>et al.</i> , 2014	40 COPD patients and 40 apparently healthy controls	6-min walk test	According to ATS guidelines for the 6-min walk test (see footnote* for details)	No significant difference in distance covered in COPD patients or apparently healthy controls
Neto <i>et al.</i> , 2015	12 high school students	Multistage 20 m shuttle run test	Given every 60 s: “Very well”, “Let’s go kid”, “Way to go”, “You can do it”, Cheer up”, “You’re almost there”.	Significant 10.2% increase in distance covered with VE compared to no VE

**ATS** = American Thoracic Society; **COPD** = chronic obstructive pulmonary disease; \* “After the first minute, tell the patient the following (in even tones): ‘You are doing well. You have 5 minutes to go.’ When the timer shows 4 minutes remaining, tell the patient the following: ‘Keep up the good work. You have 4 minutes to go.’ When the timer shows 3 minutes remaining, tell the patient the following: ‘You are doing well. You are halfway done.’ When the timer shows 2 minutes remaining, tell the patient the following: ‘Keep up the good work. You have only 2 minutes left.’ When the timer shows only 1 minute remaining, tell the patient: ‘You are doing well. You have only 1 minute to go.’ Do not use other words of encouragement (or body language to speed up).” (ATS, 2002; p.114).