CRITICALLY APPRAISED TOPIC

FOCUSED CLINICAL QUESTION

For a patient with Stage 3 Parkinson's Disease, do auditory cues or visual cues result in larger step length during gait?

AUTHOR

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CLINICAL SCENARIO

A patient who has Parkinson's Disease has progressed from stage 2 to stage 3 and is having increased difficulty with walking due to impaired balance and inability to perform rapid movements resulting in shorter step length. Will using auditory cues or visual cues during gait training better help increase step length to improve gait? The goal of gait training during PT is to improve the gait deficits observed and maintain these improvements in normal daily life. Since this patient's primary gait abnormality is decreased step length, the intervention should encourage larger steps. It is known that external cues can help people with Parkinson's walk, so for this specific patient it is helpful to know if auditory or visual cues will have a better impact on step length.

SUMMARY OF SEARCH

[Best evidence appraised and key findings]

- This search yielded 8 articles that fit the inclusion and exclusion criteria and best answered the clinical research question. These articles consisted of 1 randomized controlled trial, 1 meta-analysis, 1 systematic review, and 5 quasi-experimental repeated measures studies.
- 4 of the articles had high relevance, 2 had moderate relevance, and 2 had low relevance to the clinical question.
- Overall, the evidence shows both auditory and visual cues improve the quality of gait, however, they change different gait mechanics. Auditory cues appear to have the biggest effect on increasing step length, which is the focus of this clinical question.
- The effects of auditory cueing on step length are both statistically and clinically significant.
- There is no evidence supporting a specific protocol for appropriate use of auditory cueing to improve step length in this population.
- Acute changes in gait with auditory and visual cueing is well researched, however, there is poor understanding for how to maintain these improvements in daily life after the intervention.

CLINICAL BOTTOM LINE

This evidence shows the best way to improve step length in a patient with Stage 3 Parkinson's Disease is to use auditory cueing. There is currently no evidence to suggest what frequency in which the auditory cues should be given to elicit these changes, however, even with various protocols being used in research, similar results have been reported. This may indicate that the exact frequency is not as important as the type of cueing and whichever frequency is best increasing step length for the specific patient is appropriate to use. There is no evidence to determine the best way to promote maintenance of increased step length following the intervention.

This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor

The above information should fit onto the first page of your CAT

SEARCH STRATEGY

Terms used to guide the search strategy			
Patient/Client Group	**I**ntervention (or Assessment)	**C**omparison	**O**utcome(s)
Parkinson* Disease Parkinson* PD	Auditory cues Rhythmic auditory cues Metronome Music Acoustic cues	Visual cues Light cues Line cues	Step length Stride length

Final search strategy (history):

Show your final search strategy (full history) from PubMed.

#1: Parkinson* disease [MeSH]

#2: (auditory OR rhythmic OR metronome OR music OR acoustic) AND cue*

#3: (visual OR light OR line) AND cue*

#4: (stride OR step) AND length

#5: #1 AND (#2 OR #3) AND #4

In the table below, show how many results you got from your search from each database you searched.

Databases and Sites Searched	**Number of results**	**Limits applied, revised number of results (if applicable)**
PubMed	95	Limits: publication last 10 years and human subjects, 50 results
CINAHL	108	Limits: publication last 10 years and Parkinson disease major heading, 73 results
EMBASE	32	

INCLUSION and EXCLUSION CRITERIA

Inclusion Criteria
Used either auditory or visual cues, not a combination of the two Examined change in step length with use of auditory or visual cues Study population was Parkinson's Disease
Exclusion Criteria
Abstracts Dissertations Letters to editor Language other than English Publication older than 10 years old

RESULTS OF SEARCH

Summary of articles retrieved that met inclusion and exclusion criteria

For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).

Author (Year)	Risk of bias (quality score)*	Level of Evidence**	Relevance	Study design
De Icco, et al. (2015)[1]	PEDro: 7/11	1b	High	Randomized Controlled Trial
Spaulding, et al. (2013)[2]	AMSTAR: 4/11	1a	High	Meta-Analysis
McCandless, et al. (2016)[3]	Downs and Black: 16/31	4	Moderate	Quasi-Experimental (Repeated Measures)
Rocha, et al. (2014)[4]	AMSTAR: 8/11	1a	High	Systematic Review
Jiang and Norman (2006)[5]	Downs and Black: 15/31	4	Moderate	Quasi-Experimental (Repeated Measures)
Lewis, Byblow, and Walt (2000)[6]	Downs and Black: 16/31	4	Low	Quasi-Experimental (Nonequivalent groups pretest-posttest control group design)
Rochester, et al. (2005)[7]	Downs and Black: 17/31	4	High	Quasi-Experimental (Repeated Measures)
Baker, Rochester, and Nieuwboer (2007)[8]	Downs and Black: 17/31	4	Low	Quasi-Experimental (Repeated Measures)

*Indicate tool name and score

**Use Portney & Watkins Table 16.1 (2009); if downgraded, indicate reason why

BEST EVIDENCE

The following 2 studies were identified as the 'best' evidence and selected for critical appraisal. Rationale for selecting these studies were:

- De Icco, et al. because it has high relevance to my PICO question, has a good PEDro risk of bias score, and is a randomized controlled trial so it is a high level of evidence.
- Spaulding, et al. because it has high relevance to my PICO question and is a meta-analysis so it is the highest level of evidence. Although it has a moderate risk of bias, it provides many data points looking specifically at stride length by including 17 studies with auditory cues, 8 studies with visual cues, as well as 3 that looked at auditory or visual cues.

SUMMARY OF BEST EVIDENCE

(1) Description and appraisal of Acute and Chronic Effect of Acoustic and Visual Cues on Gait Training in Parkinson's Disease: A Randomized, Controlled Study by R. De Icco, C Tassorelli, E Berra, M Bola, C Pacchetti, and G Sandrini, 2015[1]

Aim/Objective of the Study/Systematic Review:
The objective of this study was to examine and compare the acute and chronic effects of visual cues and acoustic cues during gait training in individuals with Parkinson's Disease.

Study Design

[e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]

Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.

- This study was a 3 group randomized controlled design. Random allocation was used to place the participants in one of the following groups: Acoustic cues, Visual Cues, or No Cues (Control Group).
- There was no blinding of the participants or researchers.
- Baseline measurements were taken at the beginning of the program to allow for acute and chronic outcome assessments. Acute outcomes were measured during the treatment session. Chronic outcomes of the intervention were measured at the end of the 4 week intervention and 3 months after. The chronic effects were used to determine if the acute changes were retained and were measured by having the participant walk without cues at each of the mentioned time frames.
- The Statistical Package for Social Sciences for Windows, version 21.0, was used to perform the statistical analysis, which included a t-test and ANOVA along with other qualitative variables.

Setting

[e.g., locations such as hospital, community; rural; metropolitan; country]

This study took place at the inpatient Neuro-Rehabilitation Unit at the C. Mondino National Neurological Institute of Pavia, Italy.

Participants

[N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]

Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.

- The participants were enrolled into this study when they were admitted into the Neuro-Rehabilitation Unit of the hospital after receiving a referral from a neurologist for decline in motor function, increased falls risk, reduced walking endurance, or worsening bradykinesia.
- There were 46 patients total in this study, 24 males and 22 females.
- The average age was 74 ± 7 years.
- The average time since the Parkinson's Disease diagnosis was 10 years.
- UPDRS, FIM scores, and stride characteristics were similar for all groups at baseline.
- They were all on a stable medication regimen, had a Hoehn and Yahr stage of II, III, or IV, and had mild to no cognitive impairment.
- There were 11 participants in the Acoustic Group, 11 in the Visual Group, and 24 in the Control Group.

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

- Everyone participated in 5 exercise sessions per week for 4 weeks. Each session was 40 minutes and included passive stretching, joint mobility exercises, exercise for hypokinesia, weight shifting, balance exercises, and postural strategies to prevent falls.
- They also participated in 5 gait training sessions per week for 4 weeks. Each gait training session was 20 minutes. The control group walked over-ground with no cueing for these sessions.
- The treatment was administered in the Neuro-Rehabilitation Unit by physical therapists.

Experimental

Acoustic Group:

- Everyone participated in 5 exercise sessions per week for 4 weeks. Each session was 40 minutes and included passive stretching, joint mobility exercises, exercise for hypokinesia, weight shifting, balance exercises, and postural strategies to prevent falls.
- They also participated in 5 gait training sessions per week for 4 weeks. Each gait training session was 20 minutes. This group walked over-ground to a "beep" that was set at a personalized frequency between 60 and 120 Hz for these sessions.
- The treatment was administered in the Neuro-Rehabilitation Unit by physical therapists.

Visual Group:

- Everyone participated in 5 exercise sessions per week for 4 weeks. Each session was 40 minutes and included passive stretching, joint mobility exercises, exercise for hypokinesia, weight shifting, balance exercises, and postural strategies to prevent falls.
- They also participated in 5 gait training sessions per week for 4 weeks. Each gait training session was 20 minutes. This group walked over-ground while stepping over colored stripes on the floor that were set to personalized distances between 25 cm to 60 cm for these sessions.
- The treatment was administered in the Neuro-Rehabilitation Unit by physical therapists.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

- The primary outcome measures were number of strides, gait speed, step time duration, step length, swing time, and stance time.
- Gait mechanics were measured using a 6-camera optoelectronic system. The camera measured gait characteristics by tracking 21 reflective markers placed on each participant via the Davis protocol.
- The data was collected over a 7-meter walkway and each participant had at least 4 gaits analyzed per treatment session.
- The data collection was performed by a qualified trained technician.
- They also measured UPDRS-III and FIM scores in all 3 groups.
- All measures were collected at admission into the rehab unit, at the end of the 4 week training program, and at a 3 month follow up evaluation.
- Acute outcomes were defined as the changes that occur during the training session.
- Chronic outcomes were defined as the changes that were observed/retained at the end of the 4 week program and at the 3 month follow up without cueing.

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

Acoustic Group (Acute Effects): Acoustic cues resulted in significant increases in stride duration and stride length during the gait trial.

	Baseline (No Cues)	Acoustic Group	P Value	Effect Size*
Number of Strides	7.2 ± 3.3	7.3 ± 2.5	Not significant	.0341
Stride Duration (ms)	1250.5 ± 317.2	1374.8 ± 381.0	Significant (<0.05)	.3545
Stride Length (cm)	83.5 ± 25.7	102.1 ± 31.6	Significant (<0.05)	.6458
Stance (% of stride)	73.8 ± 7.5	75.5 ± 4.6	Not significant	.2732
Swing (% of stride)	26.2 ± 7.5	24.5 ± 4.6	Not significant	.273
Gait Speed	0.63 ± 0.22	0.69 ± 0.32	Not significant	.2185

Visual Group (Acute Effects): Visual cues resulted in significant decrease in number of strides, stance time, and gait speed and an increase in swing time during gait.

	Baseline (No Cues)	Visual Group	P Value	Effect Size*
Number of Strides	6.8 ± 2.5	4.5 ± 1.3	Significant (<0.05)	1.1543
Stride Duration (ms)	1362.9 ± 216.6	1456.7 ± 270.1	Not significant	.3831
Stride Length (cm)	84.8 ± 19.2	89.3 ± 12.0	Not significant	.2810
Stance (% of stride)	71.3 ± 3.5	65.5 ± 2.2	Significant (<0.05)	1.984
Swing (% of stride)	28.7 ± 3.5	34.5 ± 2.2	Significant (<0.05)	1.984
Gait Speed	0.62 ± 0.1	0.55 ± 0.1	Significant (<0.05)	.699

<u>Acoustic Group (Chronic Effects):</u> At the end of the 4 week gait training intervention, the acoustic cues resulted in significant decrease in number of strides and increase in stride length and gait speed. No significant changes were observed at the 3 month follow up evaluation.

	Baseline (No Cues) (T0)	End of 4-week Program (T1)	3 Month Follow-Up (T2)	P Value (T1 vs T0)	Effect Size*	P Value (T2 vs T1)	Effect Size*
Number of Strides	7.2 ± 3.3	6.2 ± 1.7	7.0 ± 4.3	Significant (<0.05)	.380	Not significant	.2446
Stride Duration (ms)	1250.5 ± 317.2	1246 ± 263.4	1292.5 ± 214.2	Not significant	.015	Not significant	.1936
Stride Length (cm)	83.5 ± 25.7	106.7 ± 10.7	91.5 ± 11.7	Significant (<0.05)	1.1785	Not significant	1.355
Stance (% of stride)	73.8 ± 7.5	70.2 ± 3.1	74.5 ± 7.0	Not significant	.627	Not significant	.7943
Swing (% of stride)	26.2 ± 7.5	28.5 ± 4.3	24.9 ± 8.9	Not significant	.3762	Not significant	.515
Gait Speed	0.63 ± 0.22	0.77 ± 0.3	0.68 ± 0.32	Significant (<0.05)	.5322	Not significant	.290

<u>Visual Group (Chronic Effects):</u> At the end of the 4 week gait training intervention, the visual cues resulted in significant decrease in number of strides and stance time and an increase in swing time and gait speed. No significant changes were observed at the 3 month follow up evaluation.

	Baseline (No Cues) (T0)	End of 4-week Program (T1)	3 Month Follow-Up (T2)	P Value (T1 vs T0)	Effect Size*	P Value (T2 vs T1)	Effect Size*
Number of Strides	6.8 ± 2.5	5.2 ± 1.0	7.1 ± 3.2	Significant (<0.05)	.840	Not significant	.8014
Stride Duration (ms)	1362.9 ± 216.6	1332.9 ± 263.1	1384.1 ± 196.1	Not significant	.124	Not significant	.2206
Stride Length (cm)	84.8 ± 19.2	94.0 ± 29.5	84.1 ± 17.0	Not significant	.3696	Not significant	.4112
Stance (% of stride)	71.3 ± 3.5	62.6 ± 4.0	70.4 ± 4.5	Significant (<0.05)	2.314	Not significant	1.832
Swing (% of stride)	27.6 ± 3.5	36.6 ± 3.5	29.1 ± 4.6	Significant (<0.05)	2.5714	Not significant	1.8350
Gait Speed	0.62 ± 0.1	0.71 ± 0.2	0.65 ± 0.60	Significant (<0.05)	.5692	Not significant	.1341

Control Group (Chronic Effects): At the end of the 4 week gait training intervention, the use of no cues resulted in significantly increased stride length and gait speed. No significant changes were observed at the 3 month follow up evaluation.

	Baseline (No Cues) (T0)	End of 4-week Program (T1)	3 Month Follow-Up (T2)	P Value (T1 vs T0)	Effect Size*	P Value (T2 vs T1)	Effect Size*
Number of Strides	7.0 ± 4.1	6.8 ± 3.5	7.4 ± 2.1	Not significant	.052	Not significant	.207
Stride Duration (ms)	1336.7 ± 247.9	1351.8 ± 267.7	1301.7 ± 254.1	Not significant	.0585	Not significant	.1919
Stride Length (cm)	86.3 ± 20.5	103.9 ± 25.6	93.3 ± 25.6	Significant (<0.05)	.7589	Not significant	.4140
Stance (% of stride)	69.5 ± 6.0	68.8 ± 6.8	67.3 ± 5.1	Not significant	.109	Not significant	.2495
Swing (% of stride)	30.2 ± 6.0	31.1 ± 6.7	31.5 ± 4.4	Not significant	.1415	Not significant	.070
Gait Speed	0.64 ± 0.2	0.74 ± 0.3	0.66 ± 0.7	Significant (<0.05)	.3922	Not significant	.1485

UPDRS-III: At the end of the 4 week gait training intervention, all 3 groups demonstrated significantly decreased scores indicating decreased disability. The improvement was gone at the 3 month follow up.

FIM scores: At the end of the 4 week gait training intervention, all groups had significantly improved scores indicating improved functional mobility. The improvement was gone at the 3 month follow up.

*Calculated from information provided in study results.

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

The authors conclude that both auditory and visual cues improve different aspects of gait for individuals with Parkinson's Disease. The changes observed in the 2 intervention groups ultimately resulted in decreased number of strides which is beneficial for these patients because Parkinson's Disease tends to increase the number of strides. The acoustic cues primarily resulted in increased stride length and they speculate this could be due to the automatic rhythm that facilitates movement. The visual cues primarily resulted in altered swing-stance cycle and they speculate this could be due to the attention required during the swing phase to reach the target. Ultimately, they conclude that both visual and auditory cues should be tried on patients with Parkinson's Disease to determine which cue works best for different patients and long-term training with continued use of cues may result in improved chronic effects on gait.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

The PEDro assessment[9] was used to evaluate the risk of bias of this randomized controlled study. This study scored a 7/11 indicating a moderate risk of bias. The elements that this study is missing all involve blinding. Neither the subjects, researchers, or therapists performing the intervention were blinded to the treatment groups. Although, a lack of blinding increases the risk of bias, in this study design it is impossible to blind the subjects or therapists because the cue cannot be hidden. It is not specifically stated who performed the statistical analysis of the data, so it cannot be determined if those individuals were blinded. To reduce the risk of bias, those individuals should be blinded to which intervention was used for each data set. There is also no information about how the participants were assigned to each treatment group so it is unknown if this process was concealed or not. Although there is a moderate risk of bias, for this study design the researchers addressed the elements that they have the ability to control which indicates they are controlling risk of bias as much as possible. Due to this, these results are likely valid for this patient population. Since this is a RCT, this study is a high level of evidence. The authors do not report any limitations in this study. Some limitations that are apparent in this study is that the authors do not report the true p values, but instead just if it is significant of not. Having the true p value included would improve the quality of the study and increase the confidence of the precision of the data. The researchers also did not report how the frequency of auditory or visual cues were determined. Without knowing this step in the methodology, the intervention would be difficult to replicate in a clinical setting. This study included a sample of people with Parkinson's who were admitted into an inpatient rehab unit. This increases the internal validity because the sample is very similar, however, this decreases the external validity because these results may not be generalized to other settings. The increased internal validity, however, is a strength of this study because it demonstrates that these results are likely true for this specific patient population. Some additional strengths include that the researchers separated the acute effects and chronic effects of cueing. Since this was conducted in an inpatient rehab setting, they were able to reduce the risk of bias and variability in how the protocol was carried out for each participant. Finally, one of the greatest strengths is that the control group consisted of individuals with Parkinson's Disease with similar baseline characteristics. This allows for a true, reliable comparison of cueing vs no cueing in this specific population.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

Based on the reported p values, acoustic cues resulted in acute improvement in stride duration and stride length. After calculating the effect size, both of these results also have a medium effect size which makes these results statistically and clinically significant. Visual cues resulted in acute improvement in number of strides, gait speed, and altered swing-stance cycles by decreasing stance time and increasing swing time. These all have large effect sizes which indicates these results are also statistically and clinically significant. At the end of the 4 week intervention, both sets of cueing significantly changed number of strides and gait speed, while acoustic cues also improved stride length and visual cues altered the swing-stance cycle. All of these results had medium to large effect sizes which indicate the results are both statistically and clinically significant. The control group also demonstrated statistically and clinically significant improvement in stride length and gait speed at the end of the 4 week intervention. Although no statistically significant results were found at the 3 month follow up, the same improved gait characteristics found in the acoustic and visual groups still had medium to large effect sizes which could mean there was a type II error due to a lack of power and only including 11 subjects. The control group did not have significant effect sizes at the 3 month follow up and had 24 subjects in each group. This means the control group likely did not maintain the improvements in gait at the follow up. Overall these results demonstrate that both acoustic and visual cues improve different aspects of gait but some of these results cannot be directly attributed to the cueing because the control group also had similar improvement with stride length and gait speed. Although the control group demonstrated some of the same improvements, cueing appears to have a higher likelihood of resulting in maintained improvement 3 months after the intervention is complete due to the large effect sizes.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

This study has high relevance to the clinical question and scenario. It independently compared the effects of acoustic cues and visual cues while also including a control group with similar individuals who have Parkinson's in order to ensure the results are truly due to the intervention. The actual protocol used in this study is only applicable in the inpatient setting due to the frequency and duration of treatment. The individual interventions, however, are applicable across many different settings. The researchers give appropriate explanation about the intervention each participant received, however, they do not explain how they determined the frequency of the auditory and acoustic cues. Without knowing if they matched the participants comfortable cadence or increased/decreased from their comfortable cadence, the same positive results may not be observed in clinical practice. This extensive type of gait training program is not feasible across most rehabilitation settings; however, the gait training interventions are. Also, as the authors stated, once the training has been completed in clinic, participants can likely continue the intervention at home and this may result in more significant long term improvement in gait mechanics for this population.

(2) Description and appraisal of Cueing and Gait Improvement Among People with Parkinson's Disease: A Meta-Analysis by S Spaulding, B Barber, M Colby, B Cormack, T Mick, and M Jenkins, 2013[2]

Aim/Objective of the Study/Systematic Review:
The aim of this study was to review current evidence to compare the effects of auditory cues, visual cues, and a combination of both on gait with individuals with Parkinson's Disease.
Study Design [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant] Note: For systematic review, use headings 'search strategy', 'selection criteria', 'methods' etc. For qualitative studies, identify data collection/analyses methods.
• This is a meta-analysis. • The researchers used the following databases: EMBASE, Scopus, Medline, CINAHL, and PubMed. • 4 of the authors were randomly assigned to search one of the databases. • Search terms included: 1) Parkinson's Disease, Parkinson, PD, Parkinson's, Parkinson's disease, Parkinson disease 2) Gait, Walking, Cadence, Step, Pace 3) Cueing, Cue, Cues, Prompt • 103 articles were found with the original search. 25 articles met the inclusion and exclusion criteria. • The primary inclusion criteria were studies that evaluated a gait training intervention that used auditory and/or visual cues in people with Parkinson's Disease who do not use assistive devices to evaluate a minimum of cadence, step length, and velocity. • The primary exclusion criteria were studies with other types of cueing, abstracts, unpublished research, and qualitative studies.
Setting [e.g., locations such as hospital, community; rural; metropolitan; country]
The specific setting for the included studies was not stated, however, since these studies consisted of gait training with specific cueing and parameters, it is likely they occurred in testing facilities such as outpatient or inpatient clinics.
Participants [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up] Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article.
• 25 articles with 28 individual data sets were included. • 16 studies evaluated auditory cues, 7 studies evaluated visual cues, 4 studies evaluated a combination of both, and 1 study evaluated auditory or visual cues. • 718 total individuals with Parkinson's Disease were evaluated. - 424 males, 294 females - The average age of participants was 65. - For the studies that reported disease duration, the average was >5 years. - Individuals with Hoehn and Yahr stage 1-4 were included across the various studies. - 4 studies required participants to be "off" medications, 22 studies required participants to be "on" medications

Intervention Investigated

[Provide details of methods, who provided treatment, when and where, how many hours of treatment provided]

Control

There is no discussion about the use of control groups or the results from this group in any of the studies included in this meta-analysis.

Experimental

- 17 studies investigated purely the effects of auditory cues on gait mechanics.
  - Reported auditory cues used included a pacer, metronome, "click tone," beeps, and music
- 7 studies investigated purely the effects of visual cues on gait mechanics.
  - Reported visual cues used included lines, optical stimulating glasses, virtual reality glasses, and lights
- 4 studies investigated the effects of a combination of auditory and visual cues on gait mechanics.
  - 3 studies combined cues at the same time
  - 1 study randomly provided visual or auditory cues throughout the gait training period
- 1 study investigated the effects of auditory or visual cues on gait mechanics by allowing the subject to select which cue he/she wanted.

Outcome Measures

[Give details of each measure, maximum possible score and range for each measure, administered by whom, where]

- Cadence
- Stride Length
- Gait Velocity
- All outcome measures were reported with a Hedges's g (effect size) and 95% confidence interval

Main Findings

[Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.]

Cadence: Overall, cueing significantly increased gait cadence. Auditory cues significantly increased gait cadence, while visual cues did not. Combining both auditory and visual cues also increased gait cadence. When the subject was permitted to choose between auditory or visual cues, no significant improvement in cadence was observed.

	Change	Hedge g	95% Confidence Interval	Significance
Overall Results	Increase	.252	.125-.139	Significant
Auditory Cues	Increase	.556	.291-.893	Significant
Visual Cues	Decrease	-.089	-.558-.381	Not Significant
Auditory + Visual Cues	Increase	.228	.074-.381	Significant
Subject Selected Cue	Increase	.247	-.162-.634	Not Significant

Stride Length: Overall, stride length significantly increased with cueing. Auditory and visual cues significantly increased stride length but a combination of the 2 or a self-selected cue did not have significant changes.

	Change	Hedge g	95% Confidence Interval	Significance
Overall Results	Increase	.486	.317-.654	Significant
Auditory Cues	Increase	.497	.289-.696	Significant
Visual Cues	Increase	.554	.072-1.036	Significant
Auditory + Visual Cues	Increase	1.302	.-.836-3.441	Not Significant
Subject Selected Cue	Increase	.346	-.080-.722	Not Significant

Gait Velocity: Auditory cues significantly increased gait velocity but visual cues or a combination of auditory and visual cues did not. Patient selected cues resulted in a significant improvement in gait velocity. Overall, cueing significantly increased gait velocity.

	Change	Hedge g	95% Confidence Interval	Significance
Overall Results	Increase	.514	.382-.647	Significant
Auditory Cues	Increase	.544	.294-.795	Significant
Visual Cues	Increase	.227	-.188-.642	Not Significant
Auditory + Visual Cues	Increase	1.063	-.907-3.033	Not Significant
Subject Selected Cue	Increase	.544	.376-.712	Significant

Original Authors' Conclusions

[Paraphrase as required. If providing a direct quote, add page number]

Overall, both auditory and visual cueing had positive improvements in stride length during gait in people with Parkinson's Disease. Auditory cues appear to be the more effective cue because it also improved gait cadence and velocity. The authors recommend that the chosen external cue to use for gait training should be dependent on what gait parameters need to be changed to improve the quality of gait in that individual. Since cadence usually increases as Parkinson's Disease progresses, further increasing cadence would likely not be beneficial, however, increasing step length and gait speed will likely be appropriate across all stages of the disease. Overall, they conclude that auditory cues are the most reliable form of external cues for improving the quality of gait and is the best method to use in clinical practice.

Critical Appraisal

Validity

[Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.]

The AMSTAR[10] was used to assess the risk of bias in this meta-analysis. This study received a score of 5/11. They were deficient in the following areas: no a priori design, no list of excluded articles, no assessment of quality of included articles, no likelihood of publication bias reported, and no conflict of interest listed for this study or the included studies. This results in a moderate risk of bias which slightly decreases the validity and credibility of these findings. The authors acknowledge this by reporting many limitations in this study including a small number of studies with small sample sizes, inconsistent protocols for cueing which makes it difficult to compare and generalize, no use of assistive devices which likely means the participants only had mild to moderate difficulty walking, and no study had a control group made of people with Parkinson's to see the effects of no cueing in that specific population. Another limitation that is evident by the risk of bias assessment is that the authors did not report or consider the risk of bias of the included studies when making their conclusions. Since the meta-analysis has a moderate risk of bias itself, if each of the studies included in the meta-analysis also had moderate to high risk of bias, this would further decrease the credibility and reliability of these findings. According to the details of the included RCTs, most of the studies examined the immediate effect of cues on gait mechanics, but some examined later effects of the cues by measuring the gait mechanics multiple weeks after the intervention. This makes it more challenging to compare the results to each other but may increase external validity which could make the results more generalizable. Some key strengths of this study were that the authors provided detailed information about the search process and the characteristics of the articles and population sample. This helps to determine which members of the population may be more likely to respond similarly since the authors have recognized that there is large variability in the study designs. Overall this study is a high level of evidence since it is a meta-analysis but is of moderate quality due to the large number of limitations and moderate risk of bias.

Interpretation of Results

[This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.]

Overall, cueing has the strongest clinical significance on stride length and gait velocity in people with Parkinson's Disease. This conclusion was made because both of those gait characteristics have a medium effect size, while cadence resulted in a small effect size. Auditory cues have the greatest effect on overall gait quality. For all measured gait characteristics, auditory cues resulted in medium effect sizes and narrow, significant 95% CI which indicates the effect is both clinically and statistically significant and there is less variability in the data. Visual cues only had clinically and statistically significant effects on stride length. Although visual cues had the largest effect size when evaluating stride length, it also had a very large confidence interval (.072-1.036) which indicates that there is large variability in the data. So, although visual cues had the larger effect size, auditory cues appear to result in the more consistent significant results due to the medium effect size and narrow 95% CI. Although this study was primarily comparing auditory and visual cueing on gait mechanics, the authors also included studies that combined auditory and visual cueing. The combined cues did not produce statistically significant results but did result in a large effect size indicating strong clinical significance. The discrepancy between effect size and 95% CI could be the result of a type II error due to lack of power. In conclusion, auditory cues appear to result in the most consistent and reliable improvements in gait mechanics compared to visual cues. A combination of auditory and visual cues may result in the better clinical outcomes; however, this study does not support this claim due to a likely type II error.

Applicability of Study Results

[Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.]

This meta-analysis had high relevance to the clinical question and scenario because it directly compared auditory and visual cues in a population of people with Parkinson's Disease that include Stage 3. The results specifically included the effects of the 2 different cues on step length, which is the primary outcome being examined in the PICO question. The full protocol for each intervention included in this meta-analysis was not disclosed, however, the majority of the types of cues that were used are practical and feasible across many different settings. Most of the auditory cues included a metronome or music. Most of the visual cues included tape on the floor or a light. The biggest obstacle to applying these results in clinic is that the protocols for each included study appear to be very different in how they determined the frequency of cues and when the effects of the intervention were measured. Although this study indicates auditory cues are the most effective form of cueing for this population, the inconsistency of the protocols makes it challenging to know how to achieve those results in a clinical setting.

SYNTHESIS AND CLINICAL IMPLICATIONS

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

These two studies were appropriate for answering this clinical question. The de Icco[1] randomized controlled study was actually inspired by the Spaulding meta-analysis. The Spaulding[2] meta-analysis found that both auditory and visual cues positively improved gait mechanics in people with Parkinson's Disease, however, they impacted different aspects of gait. De Icco, et al.[1] identified that in clinical practice patients appear to respond differently to cues based on their preference and there is little research comparing the chronic effects of auditory and visual cues after the intervention. For this reason, these 2 studies and their specific research questions complement each other nicely to provide a more extensive answer to this clinical question.

Both studies were of high quality and had moderate risk of bias and validity. The de Icco[1] study included a control group that was made of similar individuals with Parkinson's Disease which increases the homogeneity of the population and allows for more reliable comparisons across treatment groups. The Spaulding[2] meta-analysis was limited by the small number of studies and total subjects, however, it produced significant 95% confidence intervals and medium to large effect sizes for the investigated gait mechanics.

The interventions in the De Icco[1] study are applicable to the inpatient rehab setting but not necessarily to other rehab settings due to the frequency of the treatment sessions and time commitment. Although the exact protocol that was utilized may not be appropriate for all settings, the treatment provided in each session can easily be provided across almost all clinical settings. The Spaulding[2] meta-analysis consisted of many different intervention styles but the specific details were not provided to determine the applicability to various clinical settings.

Although this CAT only evaluated 2 of the 8 articles that fit the inclusion and exclusion criteria for this clinical question, the Spaulding[2] meta-analysis included the results of 3 of the remaining 6 studies[6-8]. The remaining studies either had no significant findings or were not relevant to this specific clinical scenario. The Rocha[4] systematic review concluded that external cues improve gait mechanics, however, they were unable to find significant differences between different types of cues, likely because only 7 studies were evaluated and they did not have as specific inclusion and exclusion to make it relevant to this clinical question. The other 2 studies (Jiang and McCandless)[3,5] focused on gait initiation in people with Parkinson's who experience freezing episodes by only looking at the first few steps, so their findings were not relevant to this clinical question.

Overall, these studies indicate that auditory cues are the most effective at improving step length in individuals with Parkinson's Disease. There does, however, appear to be variability in how patients will respond to this intervention. For the specific patient in the clinical scenario, gait training with auditory cues would be the best method to try because it is most likely to promote increased step length, however, there is a lack of evidence to determine if these effects will still be seen in a patient specifically with Stage 3 Parkinson's and in an outpatient physical therapy clinical setting.

Future research should investigate specific protocols for the frequency of auditory cueing in this population, including matching the individual's comfortable step cadence and increasing/decreasing the frequency of cues above/below the comfortable cadence. This would provide more clinically relevant information when developing a gait training plan for a specific patient.

Research should also investigate the effects of cueing across different stages of Parkinson's Disease. The gait mechanics in a patient with Stage 1 Parkinson's will likely look extremely different from a patient with Stage 3 Parkinson's Disease. Since all of the studies found in this search included individuals across a range of stages, applying the results to one specific patient is more challenging.

Future randomized controlled studies should also be conducted to investigate ways to encourage maintenance of positive changes in gait mechanics after the intervention is complete. Some areas of research could include implementing a home program that continues the gait training outside of the clinic or having gait training "check-in" appointments across a specific time frame to encourage maintenance of improved gait in people with Parkinson's Disease.

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