Author Response
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of mobility tasks: Timed “Up & Go” Test, self-paced walk, and Six-Minute Walk Test. The second domain is the pain experience immediately after each of these tasks. As mentioned above, the most functional one—the stair test—was dropped. Were the 3 remaining tasks measuring something congruent with Stratford and colleagues’ definition of physical function, or were they measuring timed performance of mobility tasks alone? Similarly, Stratford and colleagues’ pain scale focused on the pain associated with the timed tasks, not pain as we typically might measure it. Is this a broad enough measure of pain related to osteoarthritis, or do we need to consider a broader scale (pain visual analog scale or numeric rating scale without attribution to a task as suggested by OMERACT, or other arthritis-related pain scales)?

Stratford et al have pushed us to demand more from our measures, and specifically to make sure that our measures are measuring what they are supposed to be measuring in the way that we expect. The points raised above offer some possible explanations, all of which are testable in a study that fields both self-report and performance-based measures with attributed and non-attributed pain items and in a large enough sample to allow for even more confidence in large-sample modeling techniques, perhaps in people along the course of their experience with osteoarthritis rather than just at the end stage. The door has been opened, and the rehabilitation community could easily collaborate on such a venture.

Measurement is the application of a set of rules to get numeric quantification of attributes—in Stratford and colleagues’ case, the pain and physical function concepts. Once we believe we have a good way of measuring these concepts, we keep pushing the boundaries to make sure we can interpret the scores in ways that we should. Stratford and colleagues have done that in their study.

○ Author Response

[Stratford PW, Kennedy DM, Woodhouse LJ. Author response to invited commentary on “Performance measures provide assessments of pain and function in people with advanced osteoarthritis of the hip or knee.” Phys Ther. 2006;86:1498–1500.]

We thank Dr Beaton for her stimulating commentary, which conveys important information concerning statistical modeling and conceptual frameworks relevant to the assessment of health outcomes. Her commentary includes general insights and issues specific to our article. Beaton has organized her review under 2 headings, and we will apply the same 2 headings in response to her comments.

The Art of Statistical Modeling

We agree with Beaton’s position that art complements the science of statistical modeling in general and structural equation model specifically. Beaton wonders how information concerning a single-factor model or a model that includes the cross-loading of items on both factors would affect our conclusions. Our rationale for starting with a 2-factor model without cross-loading was that we conceptualized 2 factors with the relevant items loading uniquely on their respective factors. Although...
we did not desire cross-loading at the item-factor level, we imagined the factors would be related and allowed for a correlation between the factors. However, in response to Beaton’s query regarding additional factor loading models, we will briefly summarize the results from 2 additional analyses. The first was a confirmatory factor analysis that specified a single factor with all pain and time items loading on this factor. The chi-square value indicated a poorly fitting model ($\chi^2=419.4$, $df=20$, $P<.001$) with the following factor loadings: self-paced walk–pain = .49, stair test–pain = .44, Timed “Up & Go” Test–pain = .49, Six-Minute Walk Test–pain = .34, self-paced walk–time = .94, stair test–time = .88, Timed “Up & Go” Test–time = .92, and 6-Minute Walk Test–distance = -.84. The negative loading with distance occurs because greater distances are associated with more desirable health status levels, whereas faster times and lower pain levels are related to more desirable health status levels. Our initial 2-factor model, which specified pain and time (distance) items loading on their respective factors, yielded a chi-square value of 70.7 on 19 degrees of freedom. The difference in chi-square values between the single-factor model and our initial 2-factor model is highly significant in favor of the 2-factor model ($\chi^2=348.7$, $df=1$, $P<.001$).

The second supplementary analysis did not assume an a priori factor structure and allowed for all possible cross-loadings. We accomplished this by applying exploratory factor analysis using maximum likelihood estimation and oblique rotation. Two factors had eigenvalues greater than 1. Time/distance items loaded highly on one factor, and pain items loaded highly on the other factor. The correlation between factors was .46. The Table reports a summary of the pattern matrix factor loadings. It is evident from the Table that cross-loadings on the no-congruent factor were negligible. In summary, these supplementary analyses further support a 2-factor model that does not include a cross-loading of items.

**Conceptual Frameworks**

We have divided Beaton’s comments into the following 3 topics and respond to each in turn: (1) our application of Bellamy’s definition of lower-extremity physical function, (2) the proposition that the distinction between pain and function may diminish as the contextual complexity of an item increases (framed in the *International Classification of Functioning, Disability and Health* [ICF] lexicon, participation items are more contextually complex than activity items), and (3) the proposition that pain may be better assessed by applying nonattributed measures compared with attributed (eg, task-specific) measures of pain.

Bellamy is one of the few measure developers to offer a definition or clarifying phrase for the concept of lower-extremity functional status: “by this we mean your ability to move around and to look after yourself.”1,2 We applied Bellamy’s definition; however, we agree with Beaton’s point that, in the context of our assessment process, the performance measures focus on “the ability to move around” and not on “the ability to look after yourself.” Thus, within the ICF classification scheme, our performance measures assess aspects of activity limitation and not participation restriction.

The second point offered by Beaton is the speculation that the distinction between pain and function may become less distinct as the contextual complexity of an item or performance task increases. We are not aware of a study that has explored this exciting hypothesis prospectively. However, in a previous study that attempted to explain why the WOMAC physical function subscale could not detect deterioration identified by performance measures in patients 2 weeks after hip or knee arthroplasty, physical function items were divided into 2 sets.3 One set contained items similar to those on the WOMAC pain subscale, and the second set consisted of items not specific to the items on the WOMAC pain subscale. Item scores within each set were summed to yield total scores for the similar and not-specific item sets. The total item score for the not-specific item set detected deterioration consistent with the times from the performance tests. The item structure of the 2 sets of items is pertinent to our current discussion. All items in the set that did not detect deterioration tapped activity limitation; all but one item in the set that detected deterioration assessed participation restrictions. Although the results of this study are at odds with Beaton’s hypothesis, the study was not conceived to investigate Beaton’s hypothesis. We strongly support the need to investigate prospectively the hypothesis raised by Beaton. As a minor point, Beaton has suggested that our
stair climbing test may be more contextually complex; however, given the way this activity was framed in our investigation—without any more relevance to self-care, occupation, and recreation than the other 3 performance tests—we are uncomfortable accepting this specific example.

Beaton’s third point addresses the assessment of pain. Given the body of evidence suggesting that self-report measures of physical function are strongly influenced by pain, we examined whether a more distinct assessment of these 2 attributes could be achieved by performance measures. Our goal was to determine whether performance measures could bring into focus 2 health concepts that to date have been blurred by self-report measures. We believe that complementing, not replacing, self-report functional status and pain measures with performance measures will increase the validity of impressions of pain and physical function formed by clinicians. We concur with Beaton’s point that pain is a complex health concept and that further investigation concerning attributed and nonattributed pain ratings is warranted in a larger sample of patients.

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References
1 Bellamy N. An Evaluative Index for Clinical Trials. Hamilton, Ontario, Canada: McMaster University; 1982.

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References
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