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Progressing measurement in sport motivation with the SMS-6: A response to Pelletier, Vallerand, and Sarrazin

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Abstract

second question, we provided sound arguments for the development of the SMS-6. However, we concluded that the superiority of the SMS-6 in measuring contextual sport motivation across diverse age and cultural groups is a question for future and continuing research. Further examination of the SMS-6 is necessary before such claims can be endorsed.

**Keywords:** Measurement; Confirmatory factor analysis; Sport motivation

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**Introduction**

The original authors of the Sport Motivation Scale (SMS; Pelletier et al., 1995) progressed measurement in contextual sport motivation based on self-determination theory (SDT; Deci & Ryan, 1985). Since 1995, the SMS has been used extensively in sport motivation research. However, research has identified several limitations of the SMS—theoretically, empirically, and practically. We (Mallett, Kawabata, Newcombe, Otero-Ferero, & Jackson, 2007) developed the SMS-6 in response to the increasing evidence that the SMS required revision, by including four items measuring integrated regulation, replacing of four problematic items, and constructing a composite intrinsic motivation subscale. In our assessment of the SMS-6, we evaluated the factor structure and simplex pattern with a rigorous appraisal at the conceptual and analytical levels. In this paper, only findings from research conducted directly on the psychometric properties of the SMS (Pelletier et al., 1995) are reported; not any translated versions.

Pelletier, Vallerand, and Sarrazin’s (2007b) commentary on the SMS-6 (Mallett et al., 2007) presented arguments around two legitimate questions: “Does the SMS need revision?” and “Is the revised 6-factor SMS a better scale?” In responding to their commentary, we present evidence to challenge their arguments and provide what we believe is strong support for the re-development of the SMS. In addressing their arguments about the superiority of the SMS-6 over the SMS, we provide evidence that the SMS-6 addresses a number of problems associated with the original SMS in several ways, with the caveat that a clear demonstration of its superiority cannot be argued without further research.

**Does the SMS need to be revised?**

The SMS was developed around a well-established theory of motivation and although in the main the instrument has much theoretical and empirical support, it would be remiss of researchers

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1The examination of the standardized residual was conducted to identify potential mis-specification of the model at the item level. Moreover, structural equation modelling was employed to evaluate the simplex structure of the SMS-6.

2It cannot be assumed that because a measurement instrument has demonstrated sufficient validity and reliability in one culture, these same psychometric properties will prevail in another culture; such evidence needs to be empirically derived (Tanzer & Sim, 1999). Nonetheless, except for Brière et al. (1995), factor structure of the other language versions of the SMS was not examined using the measurement CFA model, which is comparable to Pelletier et al. (1995). In this paper, therefore, only findings from research conducted directly on the psychometric properties of the SMS (Pelletier et al., 1995) are reported to clarify the purpose of this paper, excluding any translated versions.
to ignore the mounting evidence that the SMS has several limitations. The balance of evidence suggests that there are psychometric problems with the factor structure of the SMS. It is paramount for high-quality research in sport motivation to have measurement tools whose score reliability and validity are supported through several studies with different samples. Researchers should be confident in the validity and reliability of published instruments for their target samples. Therefore, we argue on conceptual and statistical grounds that there are some problems with the SMS and that continual enhancement of its scales are warranted.

The omission of items measuring integrated regulation in the SMS is inconsistent with Deci and Ryan’s (1985) SDT and Vallerand’s (1997) Hierarchical Model of Intrinsic and Extrinsic Motivation (HMIEM). Mallett and Hanrahan (2004) reported integrated regulation as characteristic of elite athletes, however, the SMS in its current form is unable to capture this form of motivation. Therefore the primary purpose in re-developing the SMS focused on including items to measure integrated regulation, consistent with the theories of motivation upon which the instrument was based. This improvement in the SMS is also supported by Pelletier, Kabush, Vallerand, and Sharp (2007a), who have also recognized the need to include items measuring integrated regulation in their latest revised SMS.

While Pelletier et al. (2007b) argue that several studies support the factor structure of the SMS (i.e., Brière, Vallerand, Blais, & Pelletier, 1995; Li & Harmer, 1996; Pelletier et al., 1995), our review of the literature showed that while two studies specifically supported the structure of the SMS (Li & Harmer, 1996; Pelletier et al., 1995), six other studies (some with two samples) were not supportive (e.g., Hodge, Allen, & Smellie, 2007; Mallett et al., 2007; Martens & Webber, 2002; Reimer, Fink, & Fitzgerald, 2002; Shaw, Ostrow, & Beckstead, 2005; Standage, Duda, & Ntoumanis, 2003a). The main concerns reported in the literature related to: (a) an unclear factor structure (i.e., the lack of convergent validity of some items and the lack of discriminant validity with the intrinsic motivation (IM) subscales) and (b) equivocal findings relating to the adequacy of the internal consistencies of several subscales.

A detailed breakdown of the research that has specifically examined the factor structure of the SMS using confirmatory factor analysis (CFA) is presented in Table 1. Despite Pelletier et al. (2007b) reporting that overall the findings of Martens and Webber (2002) and Reimer et al. (2002) supported the validity and reliability of the SMS, the two examinations highlighted problems with model specification, with each concluding that there was “mixed support for the validity of the scale in this sample” (Reimer et al., 2002, p. 57) and “some evidence for the reliability and validity of the SMS” (Martens & Webber, 2002, p. 254). Shaw et al. (2005) also reported that the “results of psychometric testing on the SMS did not support the hypothesized factor structure of this instrument in assessing motivation in the senior athlete population” (p. 206). Furthermore, Standage et al. (2003a) also reported that although the CFA results were acceptable, the “findings suggest a lack of discriminant validity” (p. 102), and subsequently they combined four dimensions (three IM subscales and Identified Regulation) to represent self-determined motivation. Moreover, the “External Regulation subscale of the SMS deviated from the expected simplex pattern” (Standage et al., 2003a, p. 102).

The global goodness-of-fit indices reported in Li and Harmer (1996), Pelletier et al. (1995), Shaw et al. (2005), and Standage et al. (2003a) were marginally acceptable according to conventional cut-off points. However, as shown in Table 1, no study has reported an excellent overall fit of the model across multiple fit indices (i.e., CFI, NNFI > .95; SRMR, RMSEA < .05).
Table 1
Goodness-of-fit indices of 7-factor CFA models for the SMS and internal consistency coefficients

<table>
<thead>
<tr>
<th>Studies</th>
<th>Participants</th>
<th>Estimation</th>
<th>Method</th>
<th>( \chi^2 )</th>
<th>CFI</th>
<th>NNFI</th>
<th>SRMR</th>
<th>RMSEA (90% CI)</th>
<th>Cronbach’s ( \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pelletier et al. (1995)</td>
<td>Canada; Uni students (19.2 yrs)</td>
<td>ML</td>
<td></td>
<td>637.49</td>
<td>.92</td>
<td>.92</td>
<td>.05</td>
<td>–</td>
<td>.63–.80</td>
</tr>
<tr>
<td>Study 1, ( N = 593 )</td>
<td>USA; College students (20.9 yrs)</td>
<td>ML</td>
<td></td>
<td>1615.64</td>
<td>.91</td>
<td>.90</td>
<td>–</td>
<td>.08</td>
<td>–</td>
</tr>
<tr>
<td>Li and Harmer (1996)</td>
<td>USA; College students (19.8 yrs)</td>
<td>ML</td>
<td></td>
<td>749.34</td>
<td>.84</td>
<td>.82</td>
<td>–</td>
<td>–</td>
<td>.07</td>
</tr>
<tr>
<td>Martens and Webber (2002)</td>
<td>USA; College students (19.8 yrs)</td>
<td>ML</td>
<td></td>
<td>738.53</td>
<td>.92</td>
<td>–</td>
<td>.07</td>
<td>.06</td>
<td>.66–.91</td>
</tr>
<tr>
<td>Reimer et al. (2002)</td>
<td>USA; Adults over 30 yrs (50.7 yrs)</td>
<td>WLS</td>
<td></td>
<td>2438.20</td>
<td>.93</td>
<td>.93</td>
<td>–</td>
<td>.12</td>
<td>–</td>
</tr>
<tr>
<td>Sample 1, ( N = 474 )</td>
<td>USA; Adults over 30 yrs (50.7 yrs)</td>
<td>WLS</td>
<td></td>
<td>2470.10</td>
<td>.93</td>
<td>–</td>
<td>(.11–.12)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Sample 2, ( N = 466 )</td>
<td>USA; Adults over 30 yrs (50.7 yrs)</td>
<td>WLS</td>
<td></td>
<td>2438.20</td>
<td>.93</td>
<td>–</td>
<td>(.11–.12)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Standage et al. (2003a)</td>
<td>UK; Children (13.6 yrs)</td>
<td>ML</td>
<td></td>
<td>1061.30</td>
<td>.95</td>
<td>–</td>
<td>.07</td>
<td>.08</td>
<td>.74–.83</td>
</tr>
<tr>
<td>Shaw et al. (2005)</td>
<td>USA; Senior athletes (65.7 yrs)</td>
<td>ML</td>
<td></td>
<td>1117.11</td>
<td>.86</td>
<td>.84</td>
<td>.06</td>
<td>(.06–.07)</td>
<td>.73–.82</td>
</tr>
<tr>
<td>Hodge, Allen, and Smellie (2007)</td>
<td>New Zealand; Masters athletes (48.0 yrs)</td>
<td>–</td>
<td></td>
<td>–</td>
<td>–</td>
<td>.85</td>
<td>.83</td>
<td>.07</td>
<td>.72–.87</td>
</tr>
<tr>
<td>Mallett et al. (2007)</td>
<td>Australia; elite athletes and Robust</td>
<td>WLS</td>
<td></td>
<td>1106.99</td>
<td>.88</td>
<td>.86</td>
<td>.06</td>
<td>(.06–.07)</td>
<td>.73–.87</td>
</tr>
<tr>
<td>Sample 1, ( N = 614 )</td>
<td>Australia; Uni students (20.1 yrs)</td>
<td>ML</td>
<td></td>
<td>1106.99</td>
<td>.88</td>
<td>.86</td>
<td>.06</td>
<td>(.06–.07)</td>
<td>.73–.87</td>
</tr>
<tr>
<td>Mallett et al. (2007)</td>
<td>Australia; Uni students (20.0 yrs)</td>
<td>ML</td>
<td></td>
<td>1066.99</td>
<td>.88</td>
<td>.86</td>
<td>.06</td>
<td>(.06–.07)</td>
<td>.73–.87</td>
</tr>
</tbody>
</table>

Note: \( df = 329 \). AGFI: adjusted goodness-of-fit index; CFI: comparative fit index; NFI: normed fit index; NNFI: non-normed fit index; RMR: root mean square residual; SRMR: standardized root mean square residual; RMSEA: root mean square error of approximation; 90% CI: 90% confidence interval for the RMSEA point estimate; ML: maximum likelihood estimation; WLS: weighted least-squares estimation; M: male; F: female. Italicized goodness-of-fit indices are below conventional cut-off points (Byrne, 2006).

*Average age for a whole sample.
Although it may be difficult to achieve the overall fit at this level, “it is highly desirable if researchers want to have measures with good construct validity” (Marsh, Hau, & Wen, 2004, p. 325). Nonetheless, these global fit indices are concerned with the fit of the entire hypothesized model to sample covariance matrix of item scores (Bentler, 2006), and only one component in the evaluation of model sufficiency (Byrne, 2006). Because models have local mis-specifications even when satisfactory levels of global fit are achieved, the model also requires to be examined at the item level (Bentler, 2006; Byrne, 2006). The 7-factor measurement CFA model consistently had substantial local mis-specifications in the samples reported in previous studies. An examination of research findings shows that seven items (25% of all SMS items) were reported in two or more studies as loading poorly onto hypothesized factors—Items 1, 7, 9, 16, 17, 24, and 28 (Hodge et al., 2007; Mallett et al., 2007; Martens & Webber, 2002; Reimer et al., 2002; Shaw et al., 2005). Therefore, the central issue with the SMS is the frequent reporting of model mis-specification at the item level.

Some researchers may argue support for the discriminant validity of the SMS using Pearson-moment correlations. However Pearson-moment correlations tend to be lower than CFA-based inter-factor correlations that are more sensitive to measurement error (Byrne, 2006); see Pelletier et al. (1995), Standage et al. (2003a) and Standage, Duda, and Ntoumanis (2003b) for a comparison of these two types of correlations. Therefore, the issue of discriminant validity (related to the SMS) should be discussed preferably within the framework of CFA. There are four studies in which inter-correlations among seven factors were examined within CFA rather than Pearson-moment correlations: Mallett et al. (2007), Martens and Webber (2002), Pelletier et al. (1995), and Standage et al. (2003a). In three of these four studies, discriminant validity was not established for the IM factors and Identified Regulation. For example, we reported that IM accomplishment was not empirically distinguishable from IM knowledge (.92) for Sample 1 nor from IM knowledge or IM stimulation (.88 and .86, respectively) for Sample 2. In Standage et al. (2003a), correlations between the three IM and Identified Regulation ranged from .86 to .99. In Martens and Webber (2002), the correlation between IM accomplishment and IM stimulation was .85. Despite the diversity of participants in these three studies (e.g., age and different English-speaking countries), the lack of discriminant validity for IM factors and Identified Regulation was commonly observed. Moreover, External Regulation strongly correlated with high levels of self-determination factors (r range = .70–.93; Standage et al. 2003a) thus deviating from the expected simplex pattern. To manage these issues, Standage et al. subsequently combined four dimensions (three IM subscales and Identified Regulation) to represent self-determined motivation and excluded External Regulation from further analyses.

Ideally, a meta-analysis of studies using Pelletier et al.’s (1995) SMS would assist in an examination of the factorial validity of SMS responses by controlling for statistical artefacts, such as sampling and measurement error, which might cause equivocal results between single studies (Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). In conducting a meta-analysis of 25 studies (21 articles) that adopted measures of perceived locus of causality (PLOC) in the sport, exercise, and physical education contexts, Chatzisarantis et al. (2003) reported support for the discriminant validity of the three forms of IM factors used in the SMS and Exercise Motivation Scale (EMS; Li, 1999). However, only four of the 25 studies (Li & Harmer, 1996; Ntoumanis, 2001; Pelletier et al., 1995; Standage et al., 2003a) used Pelletier et al.’s (1995) SMS, making it premature to make definitive judgements on the basis of such few studies. Furthermore, more
recent studies examining the SMS (e.g., Hodge et al., 2007; Mallett et al., 2007; Martens & Webber, 2002; Reimer et al., 2002; Shaw et al., 2005) were not included in Chatzisarantis et al.’s (2003) study. Therefore, we propose that future research should embrace a meta-analytic approach to examine the factorial validity of Pelletier et al.’s (1995) SMS, including more recent studies.

A further psychometric property to be considered in evaluating an instrument is the internal reliability of its scales. In this regard, we believe that the SMS is in need of review. Cronbach’s coefficient alphas below Nunnally and Bernstein’s (1994) criterion of .70 have also been commonly reported for external motivation subscales: for Identified Regulation (Martin & Cutler, 2002; Pelletier et al., 1995; Vlachopoulos, Karageorghis, & Terry, 2000, Sample 2), for Introjected Regulation (Raedeke & Smith, 2001; Reimer et al., 2002; Standage et al., 2003a), and for External Regulation (Raedeke & Smith, 2001; Standage et al., 2003a). We deny neither the postulate that “IM could differentiate into more specific motives” (Pelletier et al., 1995, p. 36) nor several strengths of the SMS, but rather we need an instrument that can empirically demonstrate a sufficient factorial validity and reliability of responses from diverse samples. Researchers have managed this issue by removing problematic items (e.g., Mallett et al., 2007; Reimer et al., 2002; Standage et al., 2003a) and/or by collapsing subscales into composite forms of motivation (e.g., Standage et al., 2003a). Consequently, the results of these studies cannot be interpreted in any consistent way.

Overall, the evidence does not instil confidence in researchers that the SMS in its original form is a valid and reliable measure of contextual sport motivation for use with diverse samples. Although there are several strengths, there are an increasing number of studies that reported the SMS as unsatisfactory based on theoretical, empirical and practical grounds. Therefore, in the advancement of research across cultures and with different samples, a revision of the SMS was a necessary and progressive step in further promoting high-quality research using SDT (Deci & Ryan, 1985) and HMIEM (Vallerand, 1997).

Is the revised 6-factor SMS a better scale?

The superiority of the SMS-6 in measuring contextual sport motivation across diverse age and cultural groups is a question for future and continuing research. Further examination of the SMS-6 is necessary before such claims can be substantiated. However, we take this opportunity to address some of the comments by Pelletier et al. (2007b). First, in reviewing the literature on the SMS, a simple question emerges from a practical perspective—should the three IM subscales be retained despite the lack of their discriminant validity? This question emerged because scores from the three IM subscales have been repeatedly averaged to produce a single IM composite score in several studies (e.g., Pelletier, Fortier, Vallerand, & Brière, 2001; Pelletier et al., 2007a; Standage et al., 2003a). We do not deny that IM could differentiate into specific motives; however, we chose to represent it as a single scale consisting of four items because neither a first- nor higher-order model on all 12 IM items as was a resolution to the lack of discriminant validity of the three IM factors.3 We believe it is more meaningful to assist researchers in conducting studies in a

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3It was reported in Mallett et al. (2007) that the single first- and higher-order models on all 12 IM items as well as the four-item unidimensional model identified for Sample 2 were also examined for Sample 1, and the same results were
consistent way by freeing users of the SMS from managing its factorial validity issues as much as possible. A single subscale for IM was seen to be more parsimonious and practical. A more parsimonious instrument that captures the main forms of motivation and in particular, which differentiates between varying degrees of internalization, is more useful to researchers and practitioners (sport psychologists and coaches alike).

Pelletier et al. (2007b) criticized the lack of discriminant validity between IM, Integrated and Identified Regulation factors in the SMS-6. Furthermore, the revised Identified Regulation rather than Integrated Regulation or the single IM factor in the SMS-6 was identified as the problem factor. In the SMS-84 the revised Identified Regulation factor was not statistically distinguishable from Integrated Regulation and IM accomplishment, because some items in Identified Regulation that are related to the aspect of accomplishment might be interpreted similarly by an Australian sample. As we stated in our discussion, the discriminant validity issue of the revised Identified Regulation should be examined with different samples to confirm if this problem is sample specific.

Second, although Pelletier et al. (2007b) criticized our procedures in selecting the four items to best represent IM, we attempted to provide as much information as possible within space limitations. Hence, we are appreciative of this opportunity to elaborate upon the procedure we adopted in determining the four IM items—two items from IM accomplishment, one item from IM knowledge and IM stimulation each. Two items were chosen from IM accomplishment because this factor was considered to represent the nature of IM more strongly in sports due to (a) the improper solution of the higher-order model of three IM factors, and (b) the importance of accomplishment and stimulation in sport (e.g., Brière et al., 1995; Pelletier et al., 1995).

(footnote continued)

obtained. That is, the four items identified in Stage 2 were cross-validated with another independent sample (see Stage 2 in the result section in Mallett et al., 2007).

4The goodness-of-fit indices for the eight-factor measurement model (i.e., the original SMS plus integrated regulation) provided poor fit to the data of two samples. For Sample 1, was S-B $\chi^2$ (436) = 1503.021, CFI = .841, NNFI = .819, SRMR = .062, RMSEA = .063, AIC = 631.021; and for Sample 2, S-B $\chi^2$ (436) = 1374.033, CFI = .873, NNFI = .855, SRMR = .063, RMSEA = .062, AIC = 502.033.

5In the higher-order model of three IM factors, the variance of IM-accomplishment was negative (i.e., Heywood cases) for both Samples 1 and 2. Several reasons might cause improper solutions (Bollen, 1989; Chen, Bollen, Paxton, Curran, & Kirby, 2001). Because EQS automatically imposes an inequality constraint of non-negativity on each variance, AMOS (Arbuckle, 2003) was used for unconstrained estimation. Unconstrained estimations of the variance of IM-accomplishment were negative −.054 and −.127 for Samples 1 and 2, respectively. Negative variance estimates consistently emerged based on both ordinal and robust maximum likelihood methods and therefore influential cases were considered unlikely to be the cause of the improper solutions. Negative variance might also be related to an identified issue (see Bollen, 1989; Chen et al., 2001). Considering a single second-order factor consisting of three first-order factors is a just-identified model, it was assumed that the negative variance estimates of IM-accomplishment were not due to under-identification. Therefore, following Chen et al. (2001), we examined whether the negative variance estimates were due to sampling fluctuation, adopting chi-square ratio test (i.e., comparison of the likelihood values between a model with the unconstrained error variance and one that sets it to zero). The results of this test for the two samples were different. According to Chen et al., the non-significant test for Sample 1 ($\chi^2 = 1.952$, df = 1, ns) suggested that sample variability led to the negative estimate, whereas the significant test for Sample 2 ($\chi^2 = 9.319$, df = 1, $p < .01$) suggested mis-specification of the higher-order model. Considering these inconsistent results and the marginal magnitude of the negative variances (i.e., −.054 and −.127 for Samples 1 and 2, respectively), the higher-order model was re-examined constraining the variance of IM accomplishment to zero. (This is the default result of EQS.) For
Third, Pelletier et al. (2007b) commented that the content validity of the three items that we included in our revised SMS-6 were problematic. Item 22 (“I don’t seem to be enjoying my sport as much as I previously did”), which produced a factor loading of .80 in the SMS-6 (Mallett et al., 2007), is consistent with Deci and Ryan’s (1985) and Vallerand’s (1997) definition of amotivation—the relative absence of motivation, that is, “… athletes who are amotivated play their sport without purpose” (Vallerand, 1997, p. 271). Amotivation is the antithesis of IM—“experience pleasant emotions such as enjoyment” (Vallerand, 1997, p. 270)—and people who are amotivated often experience negative affect (e.g., reduced enjoyment) and loss of interest, which contributes to a lack of intentionality and subsequently amotivation. Item 22 reflects reduced intentions in playing a sport because it has become less enjoyable. If a sport motivation scale is used for data collection with both elite and sub-elite athletes at youth and senior level (e.g., Chantal, Guay, Dobrev-Martinova, & Vallerand, 1996) then Item 19 (“For the material and/or social benefits of being an athlete”), which is consistent with the definition of External Regulation, warrants inclusion as sport participants at all levels often play for social and/or material reasons (e.g., friends, trophies, money). In the SMS and SMS-6, participants are asked to respond to items addressing, “‘Why do you practice your sport?’” Item 20 (“Because training hard will improve my performance”) asks participants to respond from their perspective and is therefore compatible with the definition of Identified Regulation (personal importance, choice and valuing). Mallett and Hanrahan (2004) found that elite athletes willingly practise to improve their performance, which is consistent with Identified Regulation. Therefore, an item that measures this internalized motive is warranted.

Conclusion

Essential to examining and measuring the motivational processes conceptually based on SDT and HMIEM is an empirically clear factor structure for the SMS. The factorial validity and internal consistency issues that presently burden the SMS require recognition and continuing investigation to arrive at an instrument that can be used at all levels of participation and with diverse samples with confidence. This will be one of the great benefits of research in this area. The SMS-6 is part of this process and offers progress in this evolving field. It is now for future researchers to determine whether the SMS-6 is a “better scale” that meets the demands of a more comprehensive, yet empirically sound, description of motivational processes involved in sport participation.

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(footnote continued)
Sample 1, squared multiple correlations ($R^2$) for three first-order factors were IM accomplishment (1.00), IM knowledge (.82), and IM stimulation (.69). For Sample 2, they were IM accomplishment (1.00), IM knowledge (.74), and IM stimulation (.71). Based on these results, it was considered that a possible reason was that IM accomplishment might closely represent the global IM factor. This possibility seemed reasonable based on the findings in previous SMS studies (e.g., Brière et al., 1995; Pelletier et al., 1995).
References


