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Herbison, Jordan; Martin, Luc; Slatcher, Richard; Boardley, Ian; Benson, Alex; Sutcliffe, Jordan; McLaren, Colin; Carre, Justin; Côte, Jean; Coletti, Jennifer; Bruner, Mark W.

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The Electronically Activated Recorder (EAR): A novel approach for examining social

environments in youth sport

Jordan D. Herbison[1], Luc J. Martin[1], Richard B. Slatcher[2], Ian Boardley[3], Alex Benson[4], Jordan

Sutcliffe[5], Colin McLaren[5], Justin M. Carré[5], Jean Côté[1], Jennifer T. Coletti[1] & Mark W. Bruner[5]

Queen's University[1]
University of Georgia[2]
University of Birmingham[3]
Western University[4]
Nipissing University[5]

Address correspondence to:

Mr. Jordan Herbison
School of Kinesiology and Health Studies
Queen's University
28 Division St., Kingston, ON, K7L3N6
Email: jordan.herbison@queensu.ca

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Abstract

28   The interactions between athletes, parents, and coaches outside of the immediate training and

29   competition environments can shape sport participants' overall experiences. Accordingly,

30   researchers have explored novel approaches that enable the investigation of experiences that

31   occur beyond the sport activity itself. Technological innovations, combined with careful ethical

32   considerations, have led to the development of research methods that can be used to assess

33   participant conversations in their natural sport and social environments. This article introduces

34   sport researchers to the Electronically Activated Recorder (EAR), an ambulatory ecological

35   assessment method that provides access to daily social interactions among athletes, parents, and

36   coaches within and beyond the immediate sport activity (e.g., commute to/from activity, locker

37   rooms, hotels). The EAR software is embedded within a portable device (e.g., Android device)

38   and is programmed to record brief segments of audio from participants' daily lives. In addition to

39   discussing the utility of this approach for sport contexts, we introduce the Audio Coding System

40   for Social Environments in Sport (ACSSES), which was developed to assess the interactions

41   captured from athletes' natural sport and social environments using the EAR. Evidence for the

42   reliability and validity of the ACSSES, the associated coder training protocol, and proposed

43   implications for research are discussed.

44

45   *Keywords:* behavioural observation, coding system, social identity, moral behaviour, youth sport

46   **The Electronically Activated Recorder (EAR): A novel approach for examining social**

47   **environments in youth sport**

48   Youth sport provides participants with unique opportunities to establish meaningful

49   relationships with peers and adults (e.g., Fraser-Thomas & Côté, 2009; Smith, 2003).

50   Importantly, although the sport activity in and of itself features prominently with regard to

51   teammate and coach-athlete interactions, sports' broader social environments pertaining to

52   before and after an activity, as well as travel and social functions (e.g., team meals, fundraising

53   events, overnight stays at tournaments) cannot be overlooked. It is within these broader social

54   environments that youth are able to voluntarily and purposefully seek interactions with

55   teammates, parents, and coaches, while learning to navigate the complex social realities of team

56   membership (e.g., social hierarchies, interpersonal conflict, acceptance). Accordingly, youth

57   sport incorporates several social settings that represent fertile platforms to investigate an array of

58   factors relevant to social groups and youth development.

59   Opportunities to interact and develop relationships with peers who share interest in sport

60   can help satisfy fundamental social needs of belongingness (i.e., feelings of acceptance and

61   inclusion; Baumeister & Leary, 1995) and motivations for status (i.e., feelings of respect and

62   admiration; Anderson et al., 2015). Indeed, sport provides a rich context for individuals to learn

63   about group processes and moral interpersonal behaviours (Eys et al., 2019; McEwan &

64   Beauchamp, 2018). Although this relates to athletes across the age spectrum, it is particularly

65   relevant for children and adolescents. Several developmental frameworks specific to sport (e.g.,

66   Côté et al., 2014; Holt et al., 2017) have drawn from social-ecological perspectives and

67   developmental systems theory (Bronfenbrenner, 1999; Overton, 2015) to support this position.

68   For instance, Côté et al. (2014) and Holt et al. (2017) highlight the importance of considering

69   athletes' interactions with salient social agents (e.g., coaches, parents, and teammates) when

70   evaluating how sport involvement contributes to youth development. However, despite evidence

71   supporting the impact that social agents have on athletes while they engage in sport (e.g.,

72   Erickson & Côté, 2016; Erikstad et al., 2018), less is known about how daily interactions outside

73   of the immediate sport environment (e.g., dressing rooms, car rides, team hotels) shape athletes'

74   sport experiences (e.g., Tamminen et al., 2017).

75   A significant barrier to understanding what constitutes an adaptive and enriching sport

76   milieu is the complexity of sports' broader social environments. For instance, no two sport teams

77   are identical—they are collections of idiosyncratic individuals who interact in unique ways

78   (Carron & Eys, 2012). Accordingly, researchers are tasked with exploring particular

79   features/situations expected to influence the sport experience (e.g., selection processes for new

80   members; Benson et al., 2016; normative intergroup behaviours; Bruner et al., 2014b). Further,

81   although researchers can adopt a range of research methods to address their questions, the

82   majority of studies have relied on participants' self-reports (~69%), with only ~20% of studies

83   being conducted in natural sport environments (e.g., ~8% of studies involve observation of

84   individual in everyday settings; Meredith et al., 2017). In addition to what happens during

85   training and competition, researchers must also consider how to assess athlete experiences that

86   extend beyond the sport activity and which methodologies are ideally suited to achieving this

87   objective. For instance, consider the following anecdote of a youth athlete's sport experience:

88   *Lydia is a 13-year-old ice hockey player involved in her first season playing at a*

89   *competitive level. She practices twice per week and competes in regular season games*

90   *and tournaments during the weekends. Although she finds the increased time commitment*

91   *challenging, she enjoys the opportunity to spend time with teammates before and after*

92   *hockey. The team travels to most tournaments by bus, which means there are many*

93   *opportunities to socialize with teammates in the hotel, at restaurants, and during travel to*

94   *and from the arenas. Further, Lydia and her parents also spend more time together*

95   *because of the additional travel.*

96   Reflecting on Lydia's situation, youth sport involves a range of interactions occurring across

97   various settings that accumulate to shape the overall sport experience. Accordingly, exposure to

98   the range of interactions that occur and inevitably shape an athlete's experiences represents an

99   exciting avenue for researchers interested in youth development. The purpose of this article was

100   to describe a range of quantitative and qualitative approaches[1] that have been employed to

101   measure and/or describe sport experiences, with the overarching objective of introducing a

102   complementary and innovative method of exploring athlete experiences in naturalistic settings.

103   **Investigating Sports' Broader Social Environments Using Retrospective Self-Reports**

104   Self-report measures (e.g., questionnaires, interviews) represent the most frequently used

105   approach for assessing participants' perceptions, motivations, cognitions, emotions, and

106   behaviours in sport (Meredith et al., 2017). Indeed, sport and exercise psychology researchers

107   have traditionally used questionnaires and interviews to assess variables associated with athlete,

108   coach, and parent experiences during training and competition, and efforts have increasingly

109   been made to investigate the broader social environment surrounding sport participation (e.g.,

110   Tamminen et al., 2017; Van Hoye et al., 2016). For example, Van Hoye and colleagues (2016)

111   assessed whether coaches' engagement in health promotion activities (e.g., discussing the

112   hazards of doping; discussing the impact of sleep on performance) contributed to improved sport

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[1] A comprehensive discussion differentiating quantitative and qualitative methods is a complex
issue and is beyond the scope of this article (for a review see Creswell & Creswell, 2018).

113   experience and healthy living for youth athletes. Coaches who demonstrated respect for

114   themselves and others also had athletes who enjoyed sport, were less likely to drop out, and felt

115   better about themselves (Van Hoye et al., 2016). In a qualitative inquiry, Tamminen and

116   colleagues (2017) conducted semi-structured interviews with athletes and their parents who both

117   described the car ride home as something to either enjoy or endure. Specifically, family dyads

118   described the car ride as a valuable opportunity to discuss sport as long as the athlete viewed the

119   timing and nature of the feedback as appropriate and that the power dynamic during these

120   conversations was considered (Tamminen et al., 2017). As technological advancements have led

121   to innovations in research methodology, new approaches to self-report that aim to elicit timely

122   and accurate information have been developed.

123   Sport psychology researchers have adopted the use of photos (i.e., photovoice) and

124   videos (i.e., stimulated recall) to elicit richer and more contextually specific responses during

125   interviews with coaches and athletes (e.g., Bruner et al., 2017; McCalpin et al., 2017). Sport

126   studies utilizing photovoice have participants document their sport experiences through

127   photography, which subsequently informs interviews or focus groups to explore the meanings

128   attached to the photos (e.g., McCalpin et al., 2017). Similarly, video footage via stimulated recall

129   has been used to elicit thought processes and memories about sport experiences. For example,

130   Bruner and colleagues (2017) utilized stimulated recall during interviews with male and female

131   competitive youth ice hockey players to examine the relationship between social identity and

132   intrateam moral behaviour. Their analysis revealed that regardless of the reported frequency of

133   intrateam antisocial behaviour, athletes attributed stronger social identities to the prosocial

134   interactions they shared with teammates. Findings also indicated that antisocial teammate

135   behaviour undermined social identity in teams that reported low to median frequencies of such

136   behaviour, whereas athletes reporting higher frequencies of antisocial behaviour did not perceive

137   this effect (Bruner et al. 2017). The adaptation of photovoice and stimulated recall to sport

138   psychology research illustrates how technological integration can aid participants' self-reports,

139   yet these methods do not negate the effects of retrospection altogether.

140   Experiential sampling methods (ESM) represent a range of modern-day research tools for

141   assessing participants' patterns of behaviour across experiences or situations in real time (Conner

142   et al., 2009; Reis & Gosling, 2010). ESM enables researchers to generate insights regarding

143   intra-individual variation (and stability), how processes unfold over time, and how situational

144   occurrences connect to patterns of thought, affect, and motivation. Daily diaries are one example

145   of an ESM that is becoming more widely used in sport psychology research (e.g., Benson &

146   Bruner, 2018). Daily diary approaches prompt participants to use a range of technologies (e.g.,

147   paper-and-pencil questionnaires, electronic devices) to self-report experiences as they unfold in

148   their daily lives (Bolger et al., 2003; Reis & Gosling, 2010). Participants may report based on a

149   pre-determined schedule (i.e., interval-contingent sampling), specific events (i.e., event-

150   contingent sampling), or whenever prompted from a researcher (i.e., signal-contingent sampling;

151   Bolger et al., 2003; Conner et al., 2009; Reis & Gosling, 2010). Benson and Bruner (2018)

152   utilized a daily diary approach to assess how athletes' social identities were predicted by moral

153   behaviours. They found that athletes reported stronger perceptions of social identity with their

154   teams on days when they experienced higher-than-average prosocial behaviours from teammates,

155   and weaker perceptions of social identity on days when they experienced higher-than-average

156   antisocial behaviours from teammates. Although ESM overcome some issues related to

157   participants' recollection of sport experiences, certain limitations with self-report approaches

158   persist that can be addressed by alternative methods.

159   Concerns regarding the use of participants' self-reporting are generally reflective of

160   human retrospection. Notably, humans are susceptible to memory issues that may cause them to

161   mischaracterize experiences in several ways (e.g., transience, absent-mindedness, misattribution,

162   suggestibility, bias; Schacter, 1999). That is not to say that participants' perceptions should be

163   assumed to be inaccurate, but that it is a fundamental goal of research to aggregate different

164   accounts and information over time to provide consumers of knowledge with a holistic

165   understanding of a topic. For example, social interactions between Lydia and her parents may be

166   interpreted differently by each party involved (for an example, see Babkes & Weiss, 1999). A

167   researcher's ability to capture—as objectively as possible—such interactions while triangulating

168   the experiences with perceptions from Lydia and her parents creates a more comprehensive

169   understanding of the experience than individual perceptions alone. In this way, methods that

170   allow researchers to access participants' actual behaviours can mitigate issues related to memory

171   and biases. Such methods also provide the opportunity to explore issues around when and why

172   perceptions of past behaviour might diverge from the actual behaviours that were documented.

173   Generally, research methods that involve observation of participant behaviour shift the burden to

174   researchers who manage the materials and collection of pertinent information (e.g., video,

175   audio).

Investigating Sports' Broader Social Environments Using Behavioural Observation

177   Behavioural observation provides valuable, naturalistic information about team dynamics

178   and individual behaviour (Jonsson et al., 2006). Although there are numerous methods for

179   observing participants, the term 'behavioural observation' refers to seeing and/or hearing and

180   then systematically recording and analyzing the behaviour(s) of interest (Heyman et al., 2014).

181   The objective of behavioural observation is to capture and translate actions, interactions, and

182   emotions into an understanding of the topic (Sparkes & Smith, 2014) that can then provide an

183   ecologically rich representation of behaviour in real-time (Smith et al., 1977). Such methods

184   provide contextually specific data while also enabling researchers to collect simultaneous

185   accounts of both the physical and social interactions with little burden to participants (e.g.,

186   Erickson et al., 2011; Mckenzie & Mars, 2015). In relation to the aforementioned youth-sport

187   example, filming and analyzing video taken from one of Lydia's team practices could provide

188   insightful takeaways about coach leadership or peer interactions during training in a competitive

189   female ice hockey environment.

190   Approaches to systematic observation in youth sport research have evolved from real-

191   time field observations (e.g., Smith et al., 1977) to behavioural assessment using video

192   recordings of practice or competition (e.g., Erickson et al., 2011; Vierimaa & Côté, 2016).

193   Prominent behavioural assessment systems used in youth sport have been developed to assess

194   coach behaviours (Coaching Behaviour Assessment System [CBAS]; Smith et al., 1977), coach

195   emotions (Assessment of Coach Emotions [ACE]; Allan et al., 2016), coach-athlete interactions

196   (e.g., Coach-Athlete Interaction Coding System [CAICS], Erickson et al., 2011), and athlete-

197   athlete interactions (Athlete Behaviour Coding System [ABCS]; Vierimaa & Côté, 2016).

198   Collectively, behavioural observation systems specifically developed for sport have contributed

199   to our understanding of the behaviours that occur in immediate sport environments and how they

200   relate to important athlete perceptions (for a review, see Vierimaa et al., 2016).

201   Behavioural observation is not without its limitations. First, the interactions and

202   behaviours that are able to be reliably assessed may be incomplete because participants' verbal

203   behaviours may be missed. Second, the presence of researchers may influence participant

204   behaviours as a result of their awareness of observation (i.e., Hawthorne Effect; Sedgwick &

205   Greenwood, 2015). For instance, if a researcher were to follow, observe, and record a participant

206   as they went about their daily life, the researcher's presence could become invasive and lead to

207   inauthentic participant behaviours. A key to advancing our understanding of sport experiences,

208   then, lies in the ability to reliably access ecological information that is expected to be regulated

209   by morals, values, and norms rather than team structure or the presence of others.

210   **A Novel Approach to Assessing Social Processes in Sports' Broader Social Environments**

211   Innovations in technology and careful considerations of legal and ethical concerns have

212   provided new opportunities for researchers to observe participants' behaviours outside of

213   controlled environments (Mehl, 2017). First introduced by Mehl and colleagues (2001), the

214   Electronically Activated Recorder (EAR) is a portable device (e.g., an Android phone/tablet)

215   enabled by specialized software (i.e., EAR Android app) that functions as an ambulatory

216   ecological assessment tool programmed to sample brief audio recordings from participants

217   (Kaplan et al., 2020; Mehl, 2017)[2]. Typically, the audio recordings are limited to durations of 30

218   to 50 seconds, occurring every 9 to 12.5 minutes (i.e., interval-contingent sampling; Mehl &

219   Conner, 2012). The data collected using the EAR provide researchers with ecologically valid

220   social interaction data from settings that are otherwise difficult to directly observe, while also

221   balancing participants' and surrounding others' confidentiality considerations (Mehl & Conner,

222   2012; Mehl et al., 2012). Evidence supporting the EAR's reliability when assessing a range of

223   daily behaviours and its convergent validity with theoretically related measures (e.g., Big Five

224   personality traits; Mehl et al., 2006) can be found elsewhere (see Mehl, 2017).

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[2] EAR software for Apple's operating system (iOS) has been discontinued. Our research team has used an adapted version of iOS-based EAR software developed at Wayne State University (i.e., SlatchEAR).

225   The EAR method offers sport and exercise psychology researchers with a novel tool to

226   assess relationships between participants' daily social behaviour outside of the immediate sport

227   activity (i.e., during training, competition) and important outcomes related to sport experiences.

228   Unlike other research methods, the EAR enables the assessment of daily behaviour independent

229   of self-report (e.g., acoustic observation of teammate interactions), examination of subtle and

230   habitual behaviour that occurs at thresholds below conscious awareness (e.g., participant active

231   listening during conversations with coaches), and/or the calibration of psychosocial metrics to

232   actual behaviour (e.g., congruence between actual and perceived conflict; Mehl, 2017). Notably,

233   the EAR method does not interrupt participants' daily activities to collect information about

234   experiences—participants wear the device and are only required to recharge the battery

235   overnight. Multiple studies report low perceptions of obtrusiveness and non-compliance with

236   EAR protocols (e.g., Manson & Robbins, 2017; Mehl & Holleran, 2007). Participants habituate

237   to the presence of the EAR relatively quickly (i.e., approximately two hours), which addresses

238   concerns about limitations from other behavioural observation approaches (e.g., Hawthorne

239   Effect; Mehl & Holleran, 2007; Sedgwick & Greenwood, 2015). The EAR method offers

240   researchers a glimpse into the daily activities and interactions that influence participants'

241   experiences unlike other currently available methods.

242   **Development of the Audio Coding System for Social Environments in Sport (ACSSES)**

243   Within sport, the EAR method affords researchers opportunities to document the

244   interplay between interactions that occur outside the immediate sport activity and participants'

245   motivational, cognitive, and behavioural processes and outcomes. For instance, a glimpse into

246   Lydia's conversations with her parents and/or teammates while travelling for competitions could

247   provide new insights in relation to these interactions and recent sport performances. Although

248   audio coding systems used for the analysis of EAR data exist (e.g., Everyday Child Home

249   Observation [ECHO] coding system, Slatcher & Tobin, 2011; Social Environment Coding of

250   Sound Inventory [SECSI], Mehl & Pennebaker, 2003), the development of a valid and reliable

251   coding system was needed to accurately assess relevant social actors (i.e., coaches, teammates,

252   parents, opponents) and types of interactions (e.g., technical instruction, positive encouragement)

253   that occur in sports' broader social environments (e.g., the car ride home).

254   The development of the ACSSES followed a five-step process for developing systematic

255   coding instruments (Brewer & Jones, 2002) and was further informed by theorizing from the

256   Social Identity Approach (SIA; Haslam, 2001). The first step was to explore the need for a new

257   context specific coding instrument. This process resulted in a three-fold rationale: (a) adopting

258   the EAR method for use in sport would allow investigators to obtain observational and

259   behavioural data from athletes, coaches, referees, spectators, and parents that occur in sports'

260   broader social environments and that would otherwise be inaccessible; (b) there are no existing

261   coding instruments designed to assess content and contexts using audio data from sport

262   environments using the EAR method, and; (c) there are no existing coding instruments designed

263   to assess social identification processes observed in social interactions among athletes and key

264   social agents (i.e., teammates, coaches, and parents).

265   The second step involved a literature review aimed at informing the general structure and

266   content of the ACSSES. The literature review also served to familiarize the research team with

267   available methods of conducting behavioural and observational assessments. Initially, the review

268   focused on systematic coding instruments used to assess audio data collected using the EAR (i.e.,

269   ECHO coding system, Slatcher & Tobin, 2011; SECSI, Mehl & Pennebaker, 2003). Key features

270   of these coding systems were adapted for the ACSSES. The SECSI and ECHO coding systems

271   are organized into category clusters, or groups of coding variables, based on grouping by a

272   participant's (a) *location* (e.g., at home, in school, in transit); (b) *activity* (e.g., engaging in

273   physical activity/sport, watching TV, on the computer), and; (c) *interactions* (e.g., talking, on the

274   phone, conflict with mother/guardian). The ECHO coding system contains a fourth category

275   cluster pertaining to child and/or parent *overall* affect (e.g., happy, angry; Slatcher & Tobin,

276   2011). The category cluster format was adopted for the ACSSES because it provides a

277   standardized and repeatable approach to coding. While listening to the audio file and reading the

278   associated transcript concurrently, coders begin by assessing context (i.e., *location* and *activity*),

279   followed by specific behaviours related to the recorded social interaction (e.g., "Positive

280   Evaluation of Team from Coach"), and finally, affect, based on the target athlete's and/or head

281   coach's recorded behaviour (e.g., slamming of a door) or the emotional tone of their voice.

282   A template of the ACSSES was built within a Microsoft Excel spreadsheet, with each

283   row of the spreadsheet representing a single EAR audio recording and each column represents a

284   coding variable (insert Figshare link). When a participant's audio recordings are transcribed and

285   entered into the ACSSES template, the document is saved as a dedicated ACSESS coding sheet

286   for that participant separate from other participants' coding documents. The ACSSES

287   incorporates two coding approaches to extracting information from EAR-derived audio

288   recordings that were adapted from the ECHO coding system. When evaluating evidence within

289   specific contexts (e.g., locations, activities) or behaviours (e.g., "Positive Evaluation of Coach

290   from Target Athlete"), the ACSSES uses a binary or "molecular" coding approach to indicate the

291   presence or absence of the narrowly defined coding variable (Kaplan et al., 2020; Mehl &

292   Pennebaker, 2003; Slatcher & Tobin, 2011). The molecular approach permits behaviour-

293   frequency analysis (i.e., estimated percentage of waking time spent engaged in different

294   behaviours) and enables the calculation of what may be viewed as abstract effect sizes (i.e.,

295   number of audio data samples; Mehl, 2017). When evaluating a participant's overall affect, the

296   ACSSES uses a three-point Likert-type or "molar" coding approach to rate the degree of feelings

297   or emotions in the behaviours or tone of a participant's voice including 1 (no emotion present), 2

298   (moderate emotion), and 3 (extreme emotion; e.g., Kaplan et al., 2020; Slatcher & Tobin, 2011).

299   To date, the overall affect codes have been used as evidence to support emotion-based behaviour

300   categories within the ACSSES (e.g., "Emotional Disclosure from Target Athlete"; "General

301   Negative (comment) from Target Athlete"). Adapting these key features from the SECSI and

302   ECHO coding system were deemed important for the ACSSES because they form a well-

303   organized and coherent coding process, which has led to an established record of reliable and

304   valid analysis of the EAR-derived data (for a review, see Mehl, 2017).

305   The literature review also targeted systematic behavioural observation coding instruments

306   used to assess videos recorded within sport settings (e.g., Allan et al., 2016; Erickson et al.,

307   2011; Turnnidge & Côté, 2019; Turnnidge et al., 2014; Vierimaa & Côté, 2016). Specifically, the

308   CAICS, Para-CAICS, and ABCS informed the development of what would become categories

309   within the *behaviour* dimension relevant to ingroup behaviour (i.e., teammate interactions,

310   coach-athlete interactions). For instance, the ACSSES categories that assess technical support,

311   positive reinforcement/encouragement, and intra/interpersonal support were based on categories

312   used in the CAICS and Para-CAICS (Erickson et al., 2011; Turnnidge et al., 2014). Additionally,

313   Vierimaa and Côté's (2016) ABCS categories identifying prosocial and antisocial behaviour

314   were adapted to the ACSSES to inform categories pertaining to positive and negative evaluations

315   of individual team members and the broader team. Notably, the development of existing coding

316   instruments included the evaluation of actual behaviours that occurred in youth-sport settings

317   (Allan et al., 2016; Erickson et al., 2011; Turnnidge & Côté, 2019; Turnnidge et al., 2014;

318   Vierimaa & Côté, 2016). Further, the first authors of each of the aforementioned video coding

319   systems were consulted throughout the coding system development and coder training process.

320   The final areas of literature reviewed in development of the ACSSES were Social

321   Identity Theory (SIT; Tajfel & Turner, 1979) and Self-Categorization Theory (SCT; Turner et

322   al., 1987), known together as the SIA (Haslam, 2001). According to the SIA, when individuals

323   define themselves based on a shared social identity (i.e., as "we" or "us" versus "I" and "me"),

324   they are motivated to coordinate their behaviours in accordance with understood norms and

325   standards of the group as a means of enhancing or maintaining self-image (Haslam, 2001;

326   Haslam et al., 2009). Research has demonstrated the implications that components of SIA have

327   for athletes (e.g., moral behaviour, social and task interdependence; Bruner et al., 2014a; Evans

328   et al., 2012) and highlights sport as a useful context to study SIA's implications in the real world.

329   The review of the SIA literature informed the development of ACSSES's *behaviour* categories

330   that affirm the salience of an athlete's social identity (e.g., "Positive Evaluation of Team

331   Membership from Target Athlete"), connection with fellow team members (e.g., "Positive

332   Evaluation of Teammate from Target Athlete"), or demonstrate the sharing of information

333   relevant to the construction of a shared social identity by athletes or key social agents (e.g.,

334   "Inter-/Intrapersonal Instruction from Coach"). Together, the three areas of focus in the literature

335   review informed the general structure and preliminary list of coding categories of the ACSSES.

336   Third, the newly developed ACSSES and procedures were tested and refined to ensure

337   external and face validity. Strategies pertaining to external validity occurred concurrently

338   throughout system development. The ACSSES categories were continuously analyzed and

339   refined throughout a period of informal observation and test-coding to ensure a comprehensive

340   and clearly defined classification process for all reported behaviours (Allan et al., 2016). A

341   collection of pilot audio data using the EAR was undertaken with male and female competitive

342   athletes between the ages of 11 and 25 years. These athletes represented seven different single-

343   gender sports teams (i.e., baseball, basketball, field hockey, ice hockey, soccer, and volleyball).

344   These data were used to better understand the range of environments, activities, and interactions

345   that athletes experience during a competitive season. Additionally, ACSSES categories were

346   submitted to an expert panel of six researchers from the sport and social sub-disciplines of

347   psychology to assess the face validity of the instrument. The experts all had doctoral degrees,

348   were tenure-stream faculty members at universities in Canada, the United States, or the United

349   Kingdom, and had research programs specializing in relevant topics. Ongoing modification of

350   the ACSSES occurred over a nine-month period, during which updated drafts of the coding

351   system along with detailed rationale for changes were submitted to the expert panel on three

352   occasions.

353   An overview of the ACSSES can be found in Table 1. In total, the ACSSES contains 185

354   categories that fall within four dimensions: (a) *audio data* ($n = 14$ categories); (b) *context* ($n = 33$

355   categories); (c) *behaviour* ($n = 117$), and; (d) *overall affect* ($n = 21$). The *audio data* dimension

356   contains identifying information for each audio file (e.g., start time of recording) and audio

357   quality, and the transcripts of any participant conversation. The *context* dimension provides

358   information about who the participant is interacting with (e.g., coach), the participant's location

359   (e.g., team bus), and the activity that they are engaged in (e.g., post-game debrief). The

360   *behaviour* dimension details specific interactions between the participant and their parent(s),

361   coach(es), and/or teammate(s). Finally, the *overall affect* dimension identifies feelings and

362   emotions exhibited in a participant's tone of voice or behaviour (e.g., physically slams a door).

363   **Overview of Coder Training Protocol and Reliability Assessment**

364   The final process pertaining to the ACSSES involved steps four and five—establishing

365   inter- and intra-coder reliability of the behavioural classifications using a coder training program.

366   An essential part of coding system development involves training individuals who are able to

367   accurately and reliably code observational data (i.e., coders). The objective of coder training is to

368   familiarize trainees with the coding protocol to enable independent and reliable assessment of the

369   behaviours and contexts of interest. The coder training protocol is a resource for teaching

370   trainees the transcription and coding procedures, the parameters of the behaviours and contexts

371   of interest, and to provide illustrative examples that familiarize them with the quality and content

372   they will encounter as trained coders (Heyman et al., 2014)[3].

373   Inter-coder reliability assesses the extent to which coding instruments can differentiate

374   between coders with different ability levels, when coding evaluations are completed by different

375   coders (Stolarova et al., 2014). Ideally, different coders can identify the same contexts and

376   behaviours with a high degree of accuracy. Coders are trained until they meet 70-90% inter-

377   coder reliability with a master coder (e.g., Cicchetti, 1994; Erickson et al., 2011; Turnnidge et

378   al., 2014). For example, Turnnidge and colleagues (2014) set their reliability standard at an

379   agreement of 75% for two 10-minute video segments before progressing to full video coding.

380   Continual evaluation of coder reliability is important to ensure that pre-established standards of

381   performance are maintained (Heyman et al., 2014). Coder agreement is an important factor to

382   consider because it establishes that the codes recorded from an observation reflect a standard

383   instead of one single perspective of the observation. It is valuable to obtain coder statistics

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[3] The ACSSES Coding Manual is available via (insert Figshare link)

384   throughout a training program to assess a coder's progress and identify problematic codes that

385   may require greater attention in the training process (Suen, 1988).

386   **ACSSES coder training.** Two coders were recruited to be trained by the first author on

387   the use of the ACSSES. Over a four-week training period, the coders were systematically

388   introduced to the dimensions of the ACSSES through a combination of discussion, group coding

389   practice, and coding assignments that were to be completed between meetings. Over time, the

390   training examples used during group coding practices became more complex (i.e., involved a

391   wider range of categories), illustrating the capacity of the coding system and facilitating

392   discussions to deepen learning. Further, time was allocated during meetings to review the

393   previous week's coding assignment and to discuss sources of disagreement.

394   The two coders were each exposed to 225 examples during group coding practice

395   ($n_{examples} = 50$) and weekly coding assignments ($n_{examples} = 175$) over the four-week training

396   period. At the conclusion of the training period, each coder was given a final coding assignment

397   that included 50 of the 225 examples used during training to determine the effectiveness of the

398   coder training protocol. The final coding assignment was compared to coding completed by the

399   first author to calculate inter-coder reliability. Intraclass correlation (ICC) estimates and their

400   95% confidence intervals were calculated using SPSS statistical package version 22 (IBM corp.,

401   2013) based on a single-rating, absolute-agreement, 2-way mixed-effects model. The ICCs at the

402   conclusion of the coder training indicated good (0.75-0.90) to excellent (> 0.90) inter-coder (i.e.,

403   between individual coders and the first author) reliabilities for coded behaviour (Coder 1 = 0.94;

404   Coder 2 = 0.87). Further, intra-coder (i.e., within-coder comparison between their coding of files

405   during training and the final coding assignment) reliabilities at the conclusion of the coder

406   training program indicated good (0.75-0.90) consistency for coded behaviour (Coder 1 = 0.77;

407   Coder 2 = 0.72). In light of our decision to use percent agreement, we acknowledge the

408   possibility that coders' scores may be due in part to random guesses (i.e., false agreement;

409   McHugh, 2012). For larger data sets, it may be appropriate to use Cohen's kappa to account for

410   the potential of false agreement (McHugh, 2012).

411   **Legal and Ethical Considerations for Adopting the EAR Methodology**

412   There are a number of legal and ethical considerations pertaining to the EAR method and

413   ACSSES. This section provides an overview of our first-hand experience navigating the legal

414   and ethical challenges of the EAR method with support from institutional research boards (IRB).

415   Researchers interested in EAR methodology are encouraged to review resources provided by

416   fellow EAR researchers (see Robbins, 2017, for a discussion) and familiarize themselves with

417   relevant laws in their area of jurisdiction (e.g., municipal, state/province, and country).

418   With respect to relevant laws, North American countries provide a valuable illustration.

419   For instance, Canadian law states that the recording of a private conversation is legal if one

420   person involved in the conversation provides consent (i.e., one-party consent; Criminal Code,

421   1985, s 184[2][a]). Comparatively, certain areas of jurisdiction in the United States (e.g.,

422   California) require that every individual involved in a conversation must provide consent (i.e.,

423   two-party consent; Robbins, 2017). Therefore, researchers should consider the laws in their

424   specific region and engage in a collaborative relationship with their IRB to ensure all ethical

425   concerns are addressed. Below, interested researchers can find some basic components of our

426   IRB applications that have led to approvals at two Canadian universities.

427   Researchers should begin the recruitment process by hosting information sessions where

428   individuals who may be recorded (e.g., athletes, parents, and coaches in a sport setting) are

429   provided with an overview of the proposed research and given the opportunity to ask questions.

430   The consent forms should introduce the EAR method, explain how it will be implemented in the

431   study, and require participants to opt-in to each component of the research (e.g., pre-/post-

432   questionnaires, daily diaries, EAR). Together, these steps inform participants and their families

433   of when EAR observations will occur, which negates the expectation of privacy during

434   conversations around the EAR devices during the observation period. Once data collection

435   begins, participants should be assigned pseudonyms to de-identify their data. These pseudonyms

436   are relevant for programming the EAR software, as a "Participant ID" is imbedded in each audio

437   observation downloaded from the device. All identifiable information should be securely stored

438   offline and in a separate location from de-identified data (e.g., questionnaires). As suggested

439   elsewhere (e.g., Robbins, 2017), researchers may find it helpful to keep a "Project Status

440   Workbook" (i.e., Microsoft Excel spreadsheet) that tracks data collected and workflow status on

441   data entry and analysis, organized by participant pseudonym. These recommendations help

442   protect participants' privacy and confidentiality.

443   The collection of EAR audio recordings raises additional ethical concerns that require

444   careful consideration. Researchers can manage concerns about participant privacy by selecting a

445   sub-sample of consenting team members to participate in the EAR component of a study. This

446   sampling strategy limits the amount of observational data from a specific group and lowers the

447   risk of potential negative consequences for individuals who prefer not to wear an EAR device

448   (e.g., peer pressure). Considering that researchers' access to EAR devices is also likely to be

449   limited, distributing EAR devices across multiple teams may provide the opportunity to observe

450   different experiences (e.g., one-on-one conversations, a coaches' pre-game speech) of the same

451   event (e.g., a competitive tournament), while maximizing the number of participants available

452   for other study components (e.g., questionnaires). In fact, we recommend that EAR observation

453   periods are purposely scheduled to coincide with training or competition to maximize the

454   likelihood of capturing relevant conversations among teammates, coaches, and parents, and to

455   minimize the likelihood of capturing irrelevant conversations involving non-consenting third

456   parties. The amount of identifiable information collected during any non-consenting third-party

457   conversation can be further limited by programming brief audio recordings (e.g., 50 seconds).

458   Researchers interested in observing youth sport participants should also be aware of additional

459   ethical approvals required from schools and school boards to conduct research in educational

460   settings.

461   In relation to analyzing the EAR data, researchers should determine clear and specific

462   inclusion criteria regarding which conversations meet the aims of the research. For example, we

463   only retained conversations about team membership or sport participation that included team

464   members (i.e., athletes, coaches) and/or parents for transcription and analysis (~85-90% of EAR

465   recordings). It is also important that research assistants have protocols for reporting evidence of

466   illegal activity and harming behaviours (e.g., child abuse, elder abuse, self-harm) to superiors for

467   additional review. The legal obligation to relay evidence of a crime or abuse to authorities varies

468   by area of jurisdiction and it is the investigator's responsibility to understand and follow the

469   requirements that apply to their data collection. Investigators should also make their reporting

470   requirements clear to participants in the study's consent form. All other conversations are

471   permanently deleted at the earliest opportunity. Whereas all discernable conversation captured

472   from the recordings that meet our inclusion criteria are transcribed, only dialogue from athletes,

473   coaches, and parents on participating teams is coded using the ACSSES. Only researchers and

474   research assistants who have signed an IRB approved confidentiality agreement and have

475   undertaken the coder training program have access to the EAR data.

476   **Limitations of the EAR Methodology**

477   Even though the EAR method provides an innovative approach to explore social

478   phenomena, several key limitations require consideration. First, the EAR cannot capture non-

479   verbal behaviours that are important for contextualizing effective communication in other video

480   behavioural observation methods (e.g., Allan et al., 2016). Another limitation is the cost

481   associated with EAR research, such as acquiring devices (e.g., Android devices start at ~$60

482   CAD/device) and protective casing (~$20 CAD/case). Protective cases that include belt clips can

483   enhance the audio quality of the recordings as participants will not have the devices in their

484   pockets. Researchers may also want to consider purchasing wall ports (~$2 CAD/wall port) to

485   ensure that participants have the necessary equipment to keep the EAR devices charged and

486   functioning properly.

487   Collecting, organizing, transcribing, and coding EAR-derived audio recordings is a

488   lengthy and laborious process. Once the EAR devices are collected from participants after the

489   observation period, researchers must listen to audio recordings to determine which observations

490   meet the study's inclusion criteria. For example, if six athletes and a head coach from eight youth

491   sport teams ($N = 56$) each wear an EAR device programmed to record for 50 seconds, every 12.5

492   minutes, from 08:00-20:00 over a 3-day observation period, researchers will need to review and

493   organize ~9,000 audio recordings. Once audio files relevant to the research question are

494   identified (e.g., 10-15% of recordings or 900-1,350 audio files), researchers transcribe each

495   audio file and add the transcripts to the coding instrument where trained coders analyze the

496   data—this process may take 8 to 12 months.

497   The ACSSES also has key limitations that should be considered by researchers interested

498   in using or building on the coding instrument. For instance, the ACSSES is limited to coding

499   interactions with head coaches, parents, and teammates. The current version of the ACSSES does

500   not include categories that allow researchers to assess interactions with other key social agents

501   (e.g., siblings; Blazo & Smith, 2018). In addition, the majority of the ACSSES *behaviour* codes

502   were developed to assess assumed positive (i.e., supportive) and negative (i.e., aversive)

503   relationships (Holt-Lunstad & Uchino, 2019). Holt-Lunstad and Uchino (2019) argue that

504   researchers need to gain a better understanding of social relationships characterized by a mix of

505   positivity and negativity (i.e., ambivalent relationships) and how they influence health-related

506   behaviours (e.g., sport participation). Future research with the ACSSES could evaluate how to

507   analyze the positive and negative behaviours captured with the EAR method to examine the

508   influence of ambivalent relationships.

509   **Future Application of the EAR Methodology in Sport**

510   The EAR method and ACSSES provide sport researchers with a novel methodology to

511   address research questions involving the observation of athletes and key social agents (i.e.,

512   teammates, coaches, parents) as they interact in settings outside of the immediate sport activity.

513   Together, the EAR method and ACSSES can facilitate the assessment of a wide range of

514   research topics (e.g., intragroup behaviour, leadership behaviour, social identification processes)

515   and perspectives (e.g., athlete, coach, parent, official). Using the scenario involving Lydia, we

516   now consider possible applications of the EAR to explore her identification with her new team.

517   Lydia's story provides a context with numerous research topics for investigators to

518   choose from. Considering it is her first year with a new team, social identity may be a construct

519   of interest. For Lydia, her integration into a new team would theoretically involve social

520   identification processes in the form of interactions with her coach and teammates that would

521   introduce her to the social identity content (i.e., the morals, values, and norms of the group;

522   Reicher, 1984) of the team. If the social identity content or the way it is introduced appeals to

523   her, it would likely strengthen her identification with the team (i.e., social identity). Conversely,

524   she may not agree with the social identity content based on existing beliefs or how the new

525   information is presented, which could negatively affect her identification with the team. The

526   EAR methodology could be used with Lydia, a sample of her teammates, and her coach over a

527   period of time (e.g., tournament) to collect data about the interactions that influence team

528   members' social identification. Following transcription of all conversations that discuss sport

529   participation or team membership, trained coders would use the ACSSES to code the transcripts

530   for relevant contextual information and behaviours present in the interactions. The behavioural

531   frequency analysis could then be converted to represent a proportion of time spent engaged in

532   conversations that include target behaviours of interest, and assessed in relation to other

533   measures (e.g., pre-/post-questionnaires, daily diaries). The transcripts could also be qualitatively

534   analyzed to determine how actual leader behaviours demonstrated by Lydia's coach aligned with

535   the four Principles of Social Identity Leadership (Haslam et al., 2011). These analyses would

536   provide new insights into social identification processes and how they relate to a variety of

537   potential variables (e.g., moral behaviour, intentions to continue in sport, performance). This is

538   one example demonstrating how the EAR could be used to observe participants daily

539   experiences in ways that may have previously been difficult to undertake.

540   **Conclusion**

541   As smartphones and other wearable technologies become more imbedded in everyday

542   life, so too do the opportunities for researchers to responsibly access real-world information as it

543   unfolds (Miller, 2012). The ability to access social environments around sport where athletes,

544   coaches, and parents interact can help advance our understanding of the important, yet complex,

545   social dynamics that exist. As Tamminen and colleagues (2017) noted, youth athletes indicate

546   that private settings are where many valuable conversations related to their sport experiences

547   occur. The application of the EAR method and development of the ACSSES affords new

548   opportunities to examine temporal changes, behaviour, and daily processes that are associated

549   with short- and long-term outcomes in sport.

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