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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.

DOI:
10.1080/1750984X.2020.1790025

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

Date of resubmission: June 16th, 2020

Word count: 6,561

This work was supported by a Social Sciences and Humanities Research Council (SSHRC) Insight Grant (number 435-2016-0591).

Abstract

The interactions between athletes, parents, and coaches outside of the immediate training and competition environments can shape sport participants' overall experiences. Accordingly, researchers have explored novel approaches that enable the investigation of experiences that occur beyond the sport activity itself. Technological innovations, combined with careful ethical considerations, have led to the development of research methods that can be used to assess participant conversations in their natural sport and social environments. This article introduces sport researchers to the Electronically Activated Recorder (EAR), an ambulatory ecological assessment method that provides access to daily social interactions among athletes, parents, and coaches within and beyond the immediate sport activity (e.g., commute to/from activity, locker rooms, hotels). The EAR software is embedded within a portable device (e.g., Android device) and is programmed to record brief segments of audio from participants' daily lives. In addition to discussing the utility of this approach for sport contexts, we introduce the Audio Coding System for Social Environments in Sport (ACSSES), which was developed to assess the interactions captured from athletes' natural sport and social environments using the EAR. Evidence for the reliability and validity of the ACSSES, the associated coder training protocol, and proposed implications for research are discussed.

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

The Electronically Activated Recorder (EAR): A novel approach for examining social environments in youth sport

Youth sport provides participants with unique opportunities to establish meaningful relationships with peers and adults (e.g., Fraser-Thomas & Côté, 2009; Smith, 2003). Importantly, although the sport activity in and of itself features prominently with regard to teammate and coach-athlete interactions, sports' broader social environments pertaining to before and after an activity, as well as travel and social functions (e.g., team meals, fundraising events, overnight stays at tournaments) cannot be overlooked. It is within these broader social environments that youth are able to voluntarily and purposefully seek interactions with teammates, parents, and coaches, while learning to navigate the complex social realities of team membership (e.g., social hierarchies, interpersonal conflict, acceptance). Accordingly, youth sport incorporates several social settings that represent fertile platforms to investigate an array of factors relevant to social groups and youth development.

Opportunities to interact and develop relationships with peers who share interest in sport can help satisfy fundamental social needs of belongingness (i.e., feelings of acceptance and inclusion; Baumeister & Leary, 1995) and motivations for status (i.e., feelings of respect and admiration; Anderson et al., 2015). Indeed, sport provides a rich context for individuals to learn about group processes and moral interpersonal behaviours (Eys et al., 2019; McEwan & Beauchamp, 2018). Although this relates to athletes across the age spectrum, it is particularly relevant for children and adolescents. Several developmental frameworks specific to sport (e.g., Côté et al., 2014; Holt et al., 2017) have drawn from social-ecological perspectives and developmental systems theory (Bronfenbrenner, 1999; Overton, 2015) to support this position. For instance, Côté et al. (2014) and Holt et al. (2017) highlight the importance of considering

athletes' interactions with salient social agents (e.g., coaches, parents, and teammates) when evaluating how sport involvement contributes to youth development. However, despite evidence supporting the impact that social agents have on athletes while they engage in sport (e.g., Erickson & Côté, 2016; Erikstad et al., 2018), less is known about how daily interactions outside of the immediate sport environment (e.g., dressing rooms, car rides, team hotels) shape athletes' sport experiences (e.g., Tamminen et al., 2017).

A significant barrier to understanding what constitutes an adaptive and enriching sport milieu is the complexity of sports' broader social environments. For instance, no two sport teams are identical—they are collections of idiosyncratic individuals who interact in unique ways (Carron & Eys, 2012). Accordingly, researchers are tasked with exploring particular features/situations expected to influence the sport experience (e.g., selection processes for new members; Benson et al., 2016; normative intergroup behaviours; Bruner et al., 2014b). Further, although researchers can adopt a range of research methods to address their questions, the majority of studies have relied on participants' self-reports (~69%), with only ~20% of studies being conducted in natural sport environments (e.g., ~8% of studies involve observation of individual in everyday settings; Meredith et al., 2017). In addition to what happens during training and competition, researchers must also consider how to assess athlete experiences that extend beyond the sport activity and which methodologies are ideally suited to achieving this objective. For instance, consider the following anecdote of a youth athlete's sport experience:

> *Lydia is a 13-year-old ice hockey player involved in her first season playing at a competitive level. She practices twice per week and competes in regular season games and tournaments during the weekends. Although she finds the increased time commitment challenging, she enjoys the opportunity to spend time with teammates before and after*

hockey. The team travels to most tournaments by bus, which means there are many opportunities to socialize with teammates in the hotel, at restaurants, and during travel to and from the arenas. Further, Lydia and her parents also spend more time together because of the additional travel.

Reflecting on Lydia's situation, youth sport involves a range of interactions occurring across various settings that accumulate to shape the overall sport experience. Accordingly, exposure to the range of interactions that occur and inevitably shape an athlete's experiences represents an exciting avenue for researchers interested in youth development. The purpose of this article was to describe a range of quantitative and qualitative approaches[1] that have been employed to measure and/or describe sport experiences, with the overarching objective of introducing a complementary and innovative method of exploring athlete experiences in naturalistic settings.

Investigating Sports' Broader Social Environments Using Retrospective Self-Reports

Self-report measures (e.g., questionnaires, interviews) represent the most frequently used approach for assessing participants' perceptions, motivations, cognitions, emotions, and behaviours in sport (Meredith et al., 2017). Indeed, sport and exercise psychology researchers have traditionally used questionnaires and interviews to assess variables associated with athlete, coach, and parent experiences during training and competition, and efforts have increasingly been made to investigate the broader social environment surrounding sport participation (e.g., Tamminen et al., 2017; Van Hoye et al., 2016). For example, Van Hoye and colleagues (2016) assessed whether coaches' engagement in health promotion activities (e.g., discussing the hazards of doping; discussing the impact of sleep on performance) contributed to improved sport

[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).

experience and healthy living for youth athletes. Coaches who demonstrated respect for themselves and others also had athletes who enjoyed sport, were less likely to drop out, and felt better about themselves (Van Hoye et al., 2016). In a qualitative inquiry, Tamminen and colleagues (2017) conducted semi-structured interviews with athletes and their parents who both described the car ride home as something to either enjoy or endure. Specifically, family dyads described the car ride as a valuable opportunity to discuss sport as long as the athlete viewed the timing and nature of the feedback as appropriate and that the power dynamic during these conversations was considered (Tamminen et al., 2017). As technological advancements have led to innovations in research methodology, new approaches to self-report that aim to elicit timely and accurate information have been developed.

Sport psychology researchers have adopted the use of photos (i.e., photovoice) and videos (i.e., stimulated recall) to elicit richer and more contextually specific responses during interviews with coaches and athletes (e.g., Bruner et al., 2017; McCalpin et al., 2017). Sport studies utilizing photovoice have participants document their sport experiences through photography, which subsequently informs interviews or focus groups to explore the meanings attached to the photos (e.g., McCalpin et al., 2017). Similarly, video footage via stimulated recall has been used to elicit thought processes and memories about sport experiences. For example, Bruner and colleagues (2017) utilized stimulated recall during interviews with male and female competitive youth ice hockey players to examine the relationship between social identity and intrateam moral behaviour. Their analysis revealed that regardless of the reported frequency of intrateam antisocial behaviour, athletes attributed stronger social identities to the prosocial interactions they shared with teammates. Findings also indicated that antisocial teammate behaviour undermined social identity in teams that reported low to median frequencies of such

behaviour, whereas athletes reporting higher frequencies of antisocial behaviour did not perceive this effect (Bruner et al. 2017). The adaptation of photovoice and stimulated recall to sport psychology research illustrates how technological integration can aid participants' self-reports, yet these methods do not negate the effects of retrospection altogether.

Experiential sampling methods (ESM) represent a range of modern-day research tools for assessing participants' patterns of behaviour across experiences or situations in real time (Conner et al., 2009; Reis & Gosling, 2010). ESM enables researchers to generate insights regarding intra-individual variation (and stability), how processes unfold over time, and how situational occurrences connect to patterns of thought, affect, and motivation. Daily diaries are one example of an ESM that is becoming more widely used in sport psychology research (e.g., Benson & Bruner, 2018). Daily diary approaches prompt participants to use a range of technologies (e.g., paper-and-pencil questionnaires, electronic devices) to self-report experiences as they unfold in their daily lives (Bolger et al., 2003; Reis & Gosling, 2010). Participants may report based on a pre-determined schedule (i.e., interval-contingent sampling), specific events (i.e., event-contingent sampling), or whenever prompted from a researcher (i.e., signal-contingent sampling; Bolger et al., 2003; Conner et al., 2009; Reis & Gosling, 2010). Benson and Bruner (2018) utilized a daily diary approach to assess how athletes' social identities were predicted by moral behaviours. They found that athletes reported stronger perceptions of social identity with their teams on days when they experienced higher-than-average prosocial behaviours from teammates, and weaker perceptions of social identity on days when they experienced higher-than-average antisocial behaviours from teammates. Although ESM overcome some issues related to participants' recollection of sport experiences, certain limitations with self-report approaches persist that can be addressed by alternative methods.

Concerns regarding the use of participants' self-reporting are generally reflective of human retrospection. Notably, humans are susceptible to memory issues that may cause them to mischaracterize experiences in several ways (e.g., transience, absent-mindedness, misattribution, suggestibility, bias; Schacter, 1999). That is not to say that participants' perceptions should be assumed to be inaccurate, but that it is a fundamental goal of research to aggregate different accounts and information over time to provide consumers of knowledge with a holistic understanding of a topic. For example, social interactions between Lydia and her parents may be interpreted differently by each party involved (for an example, see Babkes & Weiss, 1999). A researcher's ability to capture—as objectively as possible—such interactions while triangulating the experiences with perceptions from Lydia and her parents creates a more comprehensive understanding of the experience than individual perceptions alone. In this way, methods that allow researchers to access participants' actual behaviours can mitigate issues related to memory and biases. Such methods also provide the opportunity to explore issues around when and why perceptions of past behaviour might diverge from the actual behaviours that were documented. Generally, research methods that involve observation of participant behaviour shift the burden to researchers who manage the materials and collection of pertinent information (e.g., video, audio).

Investigating Sports' Broader Social Environments Using Behavioural Observation

Behavioural observation provides valuable, naturalistic information about team dynamics and individual behaviour (Jonsson et al., 2006). Although there are numerous methods for observing participants, the term 'behavioural observation' refers to seeing and/or hearing and then systematically recording and analyzing the behaviour(s) of interest (Heyman et al., 2014). The objective of behavioural observation is to capture and translate actions, interactions, and

emotions into an understanding of the topic (Sparkes & Smith, 2014) that can then provide an ecologically rich representation of behaviour in real-time (Smith et al., 1977). Such methods provide contextually specific data while also enabling researchers to collect simultaneous accounts of both the physical and social interactions with little burden to participants (e.g., Erickson et al., 2011; Mckenzie & Mars, 2015). In relation to the aforementioned youth-sport example, filming and analyzing video taken from one of Lydia's team practices could provide insightful takeaways about coach leadership or peer interactions during training in a competitive female ice hockey environment.

Approaches to systematic observation in youth sport research have evolved from real-time field observations (e.g., Smith et al., 1977) to behavioural assessment using video recordings of practice or competition (e.g., Erickson et al., 2011; Vierimaa & Côté, 2016). Prominent behavioural assessment systems used in youth sport have been developed to assess coach behaviours (Coaching Behaviour Assessment System [CBAS]; Smith et al., 1977), coach emotions (Assessment of Coach Emotions [ACE]; Allan et al., 2016), coach-athlete interactions (e.g., Coach-Athlete Interaction Coding System [CAICS], Erickson et al., 2011), and athlete-athlete interactions (Athlete Behaviour Coding System [ABCS]; Vierimaa & Côté, 2016). Collectively, behavioural observation systems specifically developed for sport have contributed to our understanding of the behaviours that occur in immediate sport environments and how they relate to important athlete perceptions (for a review, see Vierimaa et al., 2016).

Behavioural observation is not without its limitations. First, the interactions and behaviours that are able to be reliably assessed may be incomplete because participants' verbal behaviours may be missed. Second, the presence of researchers may influence participant behaviours as a result of their awareness of observation (i.e., Hawthorne Effect; Sedgwick &

Greenwood, 2015). For instance, if a researcher were to follow, observe, and record a participant as they went about their daily life, the researcher's presence could become invasive and lead to inauthentic participant behaviours. A key to advancing our understanding of sport experiences, then, lies in the ability to reliably access ecological information that is expected to be regulated by morals, values, and norms rather than team structure or the presence of others.

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

Innovations in technology and careful considerations of legal and ethical concerns have provided new opportunities for researchers to observe participants' behaviours outside of controlled environments (Mehl, 2017). First introduced by Mehl and colleagues (2001), the Electronically Activated Recorder (EAR) is a portable device (e.g., an Android phone/tablet) enabled by specialized software (i.e., EAR Android app) that functions as an ambulatory ecological assessment tool programmed to sample brief audio recordings from participants (Kaplan et al., 2020; Mehl, 2017)[2]. Typically, the audio recordings are limited to durations of 30 to 50 seconds, occurring every 9 to 12.5 minutes (i.e., interval-contingent sampling; Mehl & Conner, 2012). The data collected using the EAR provide researchers with ecologically valid social interaction data from settings that are otherwise difficult to directly observe, while also balancing participants' and surrounding others' confidentiality considerations (Mehl & Conner, 2012; Mehl et al., 2012). Evidence supporting the EAR's reliability when assessing a range of daily behaviours and its convergent validity with theoretically related measures (e.g., Big Five personality traits; Mehl et al., 2006) can be found elsewhere (see Mehl, 2017).

[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).

The EAR method offers sport and exercise psychology researchers with a novel tool to assess relationships between participants' daily social behaviour outside of the immediate sport activity (i.e., during training, competition) and important outcomes related to sport experiences. Unlike other research methods, the EAR enables the assessment of daily behaviour independent of self-report (e.g., acoustic observation of teammate interactions), examination of subtle and habitual behaviour that occurs at thresholds below conscious awareness (e.g., participant active listening during conversations with coaches), and/or the calibration of psychosocial metrics to actual behaviour (e.g., congruence between actual and perceived conflict; Mehl, 2017). Notably, the EAR method does not interrupt participants' daily activities to collect information about experiences—participants wear the device and are only required to recharge the battery overnight. Multiple studies report low perceptions of obtrusiveness and non-compliance with EAR protocols (e.g., Manson & Robbins, 2017; Mehl & Holleran, 2007). Participants habituate to the presence of the EAR relatively quickly (i.e., approximately two hours), which addresses concerns about limitations from other behavioural observation approaches (e.g., Hawthorne Effect; Mehl & Holleran, 2007; Sedgwick & Greenwood, 2015). The EAR method offers researchers a glimpse into the daily activities and interactions that influence participants' experiences unlike other currently available methods.

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

Within sport, the EAR method affords researchers opportunities to document the interplay between interactions that occur outside the immediate sport activity and participants' motivational, cognitive, and behavioural processes and outcomes. For instance, a glimpse into Lydia's conversations with her parents and/or teammates while travelling for competitions could provide new insights in relation to these interactions and recent sport performances. Although

audio coding systems used for the analysis of EAR data exist (e.g., Everyday Child Home Observation [ECHO] coding system, Slatcher & Tobin, 2011; Social Environment Coding of Sound Inventory [SECSI], Mehl & Pennebaker, 2003), the development of a valid and reliable coding system was needed to accurately assess relevant social actors (i.e., coaches, teammates, parents, opponents) and types of interactions (e.g., technical instruction, positive encouragement) that occur in sports' broader social environments (e.g., the car ride home).

The development of the ACSSES followed a five-step process for developing systematic coding instruments (Brewer & Jones, 2002) and was further informed by theorizing from the Social Identity Approach (SIA; Haslam, 2001). The first step was to explore the need for a new context specific coding instrument. This process resulted in a three-fold rationale: (a) adopting the EAR method for use in sport would allow investigators to obtain observational and behavioural data from athletes, coaches, referees, spectators, and parents that occur in sports' broader social environments and that would otherwise be inaccessible; (b) there are no existing coding instruments designed to assess content and contexts using audio data from sport environments using the EAR method, and; (c) there are no existing coding instruments designed to assess social identification processes observed in social interactions among athletes and key social agents (i.e., teammates, coaches, and parents).

The second step involved a literature review aimed at informing the general structure and content of the ACSSES. The literature review also served to familiarize the research team with available methods of conducting behavioural and observational assessments. Initially, the review focused on systematic coding instruments used to assess audio data collected using the EAR (i.e., ECHO coding system, Slatcher & Tobin, 2011; SECSI, Mehl & Pennebaker, 2003). Key features of these coding systems were adapted for the ACSSES. The SECSI and ECHO coding systems

are organized into category clusters, or groups of coding variables, based on grouping by a participant's (a) *location* (e.g., at home, in school, in transit); (b) *activity* (e.g., engaging in physical activity/sport, watching TV, on the computer), and; (c) *interactions* (e.g., talking, on the phone, conflict with mother/guardian). The ECHO coding system contains a fourth category cluster pertaining to child and/or parent *overall* affect (e.g., happy, angry; Slatcher & Tobin, 2011). The category cluster format was adopted for the ACSSES because it provides a standardized and repeatable approach to coding. While listening to the audio file and reading the associated transcript concurrently, coders begin by assessing context (i.e., *location* and *activity*), followed by specific behaviours related to the recorded social interaction (e.g., "Positive Evaluation of Team from Coach"), and finally, affect, based on the target athlete's and/or head coach's recorded behaviour (e.g., slamming of a door) or the emotional tone of their voice.

A template of the ACSSES was built within a Microsoft Excel spreadsheet, with each row of the spreadsheet representing a single EAR audio recording and each column represents a coding variable (insert Figshare link). When a participant's audio recordings are transcribed and entered into the ACSSES template, the document is saved as a dedicated ACSESS coding sheet for that participant separate from other participants' coding documents. The ACSSES incorporates two coding approaches to extracting information from EAR-derived audio recordings that were adapted from the ECHO coding system. When evaluating evidence within specific contexts (e.g., locations, activities) or behaviours (e.g., "Positive Evaluation of Coach from Target Athlete"), the ACSSES uses a binary or "molecular" coding approach to indicate the presence or absence of the narrowly defined coding variable (Kaplan et al., 2020; Mehl & Pennebaker, 2003; Slatcher & Tobin, 2011). The molecular approach permits behaviour-frequency analysis (i.e., estimated percentage of waking time spent engaged in different

behaviours) and enables the calculation of what may be viewed as abstract effect sizes (i.e., number of audio data samples; Mehl, 2017). When evaluating a participant's overall affect, the ACSSES uses a three-point Likert-type or "molar" coding approach to rate the degree of feelings or emotions in the behaviours or tone of a participant's voice including 1 (no emotion present), 2 (moderate emotion), and 3 (extreme emotion; e.g., Kaplan et al., 2020; Slatcher & Tobin, 2011). To date, the overall affect codes have been used as evidence to support emotion-based behaviour categories within the ACSSES (e.g., "Emotional Disclosure from Target Athlete"; "General Negative (comment) from Target Athlete"). Adapting these key features from the SECSI and ECHO coding system were deemed important for the ACSSES because they form a well-organized and coherent coding process, which has led to an established record of reliable and valid analysis of the EAR-derived data (for a review, see Mehl, 2017).

The literature review also targeted systematic behavioural observation coding instruments used to assess videos recorded within sport settings (e.g., Allan et al., 2016; Erickson et al., 2011; Turnnidge & Côté, 2019; Turnnidge et al., 2014; Vierimaa & Côté, 2016). Specifically, the CAICS, Para-CAICS, and ABCS informed the development of what would become categories within the *behaviour* dimension relevant to ingroup behaviour (i.e., teammate interactions, coach-athlete interactions). For instance, the ACSSES categories that assess technical support, positive reinforcement/encouragement, and intra/interpersonal support were based on categories used in the CAICS and Para-CAICS (Erickson et al., 2011; Turnnidge et al., 2014). Additionally, Vierimaa and Côté's (2016) ABCS categories identifying prosocial and antisocial behaviour were adapted to the ACSSES to inform categories pertaining to positive and negative evaluations of individual team members and the broader team. Notably, the development of existing coding instruments included the evaluation of actual behaviours that occurred in youth-sport settings

(Allan et al., 2016; Erickson et al., 2011; Turnnidge & Côté, 2019; Turnnidge et al., 2014; Vierimaa & Côté, 2016). Further, the first authors of each of the aforementioned video coding systems were consulted throughout the coding system development and coder training process.

The final areas of literature reviewed in development of the ACSSES were Social Identity Theory (SIT; Tajfel & Turner, 1979) and Self-Categorization Theory (SCT; Turner et al., 1987), known together as the SIA (Haslam, 2001). According to the SIA, when individuals define themselves based on a shared social identity (i.e., as "we" or "us" versus "I" and "me"), they are motivated to coordinate their behaviours in accordance with understood norms and standards of the group as a means of enhancing or maintaining self-image (Haslam, 2001; Haslam et al., 2009). Research has demonstrated the implications that components of SIA have for athletes (e.g., moral behaviour, social and task interdependence; Bruner et al., 2014a; Evans et al., 2012) and highlights sport as a useful context to study SIA's implications in the real world. The review of the SIA literature informed the development of ACSSES's *behaviour* categories that affirm the salience of an athlete's social identity (e.g., "Positive Evaluation of Team Membership from Target Athlete"), connection with fellow team members (e.g., "Positive Evaluation of Teammate from Target Athlete"), or demonstrate the sharing of information relevant to the construction of a shared social identity by athletes or key social agents (e.g., "Inter-/Intrapersonal Instruction from Coach"). Together, the three areas of focus in the literature review informed the general structure and preliminary list of coding categories of the ACSSES.

Third, the newly developed ACSSES and procedures were tested and refined to ensure external and face validity. Strategies pertaining to external validity occurred concurrently throughout system development. The ACSSES categories were continuously analyzed and refined throughout a period of informal observation and test-coding to ensure a comprehensive

and clearly defined classification process for all reported behaviours (Allan et al., 2016). A collection of pilot audio data using the EAR was undertaken with male and female competitive athletes between the ages of 11 and 25 years. These athletes represented seven different single-gender sports teams (i.e., baseball, basketball, field hockey, ice hockey, soccer, and volleyball). These data were used to better understand the range of environments, activities, and interactions that athletes experience during a competitive season. Additionally, ACSSES categories were submitted to an expert panel of six researchers from the sport and social sub-disciplines of psychology to assess the face validity of the instrument. The experts all had doctoral degrees, were tenure-stream faculty members at universities in Canada, the United States, or the United Kingdom, and had research programs specializing in relevant topics. Ongoing modification of the ACSSES occurred over a nine-month period, during which updated drafts of the coding system along with detailed rationale for changes were submitted to the expert panel on three occasions.

An overview of the ACSSES can be found in Table 1. In total, the ACSSES contains 185 categories that fall within four dimensions: (a) *audio data* (n = 14 categories); (b) *context* (n = 33 categories); (c) *behaviour* (n = 117), and; (d) *overall affect* (n = 21). The *audio data* dimension contains identifying information for each audio file (e.g., start time of recording) and audio quality, and the transcripts of any participant conversation. The *context* dimension provides information about who the participant is interacting with (e.g., coach), the participant's location (e.g., team bus), and the activity that they are engaged in (e.g., post-game debrief). The *behaviour* dimension details specific interactions between the participant and their parent(s), coach(es), and/or teammate(s). Finally, the *overall affect* dimension identifies feelings and emotions exhibited in a participant's tone of voice or behaviour (e.g., physically slams a door).

Overview of Coder Training Protocol and Reliability Assessment

The final process pertaining to the ACSSES involved steps four and five—establishing inter- and intra-coder reliability of the behavioural classifications using a coder training program. An essential part of coding system development involves training individuals who are able to accurately and reliably code observational data (i.e., coders). The objective of coder training is to familiarize trainees with the coding protocol to enable independent and reliable assessment of the behaviours and contexts of interest. The coder training protocol is a resource for teaching trainees the transcription and coding procedures, the parameters of the behaviours and contexts of interest, and to provide illustrative examples that familiarize them with the quality and content they will encounter as trained coders (Heyman et al., 2014)[3].

Inter-coder reliability assesses the extent to which coding instruments can differentiate between coders with different ability levels, when coding evaluations are completed by different coders (Stolarova et al., 2014). Ideally, different coders can identify the same contexts and behaviours with a high degree of accuracy. Coders are trained until they meet 70-90% inter-coder reliability with a master coder (e.g., Cicchetti, 1994; Erickson et al., 2011; Turnnidge et al., 2014). For example, Turnnidge and colleagues (2014) set their reliability standard at an agreement of 75% for two 10-minute video segments before progressing to full video coding. Continual evaluation of coder reliability is important to ensure that pre-established standards of performance are maintained (Heyman et al., 2014). Coder agreement is an important factor to consider because it establishes that the codes recorded from an observation reflect a standard instead of one single perspective of the observation. It is valuable to obtain coder statistics

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

throughout a training program to assess a coder's progress and identify problematic codes that may require greater attention in the training process (Suen, 1988).

ACSSES coder training. Two coders were recruited to be trained by the first author on the use of the ACSSES. Over a four-week training period, the coders were systematically introduced to the dimensions of the ACSSES through a combination of discussion, group coding practice, and coding assignments that were to be completed between meetings. Over time, the training examples used during group coding practices became more complex (i.e., involved a wider range of categories), illustrating the capacity of the coding system and facilitating discussions to deepen learning. Further, time was allocated during meetings to review the previous week's coding assignment and to discuss sources of disagreement.

The two coders were each exposed to 225 examples during group coding practice ($n_{examples}$ = 50) and weekly coding assignments ($n_{examples}$ = 175) over the four-week training period. At the conclusion of the training period, each coder was given a final coding assignment that included 50 of the 225 examples used during training to determine the effectiveness of the coder training protocol. The final coding assignment was compared to coding completed by the first author to calculate inter-coder reliability. Intraclass correlation (ICC) estimates and their 95% confidence intervals were calculated using SPSS statistical package version 22 (IBM corp., 2013) based on a single-rating, absolute-agreement, 2-way mixed-effects model. The ICCs at the conclusion of the coder training indicated good (0.75-0.90) to excellent (> 0.90) inter-coder (i.e., between individual coders and the first author) reliabilities for coded behaviour (Coder 1 = 0.94; Coder 2 = 0.87). Further, intra-coder (i.e., within-coder comparison between their coding of files during training and the final coding assignment) reliabilities at the conclusion of the coder training program indicated good (0.75-0.90) consistency for coded behaviour (Coder 1 = 0.77;

Coder 2 = 0.72). In light of our decision to use percent agreement, we acknowledge the possibility that coders' scores may be due in part to random guesses (i.e., false agreement; McHugh, 2012). For larger data sets, it may be appropriate to use Cohen's kappa to account for the potential of false agreement (McHugh, 2012).

Legal and Ethical Considerations for Adopting the EAR Methodology

There are a number of legal and ethical considerations pertaining to the EAR method and ACSSES. This section provides an overview of our first-hand experience navigating the legal and ethical challenges of the EAR method with support from institutional research boards (IRB). Researchers interested in EAR methodology are encouraged to review resources provided by fellow EAR researchers (see Robbins, 2017, for a discussion) and familiarize themselves with relevant laws in their area of jurisdiction (e.g., municipal, state/province, and country).

With respect to relevant laws, North American countries provide a valuable illustration. For instance, Canadian law states that the recording of a private conversation is legal if one person involved in the conversation provides consent (i.e., one-party consent; Criminal Code, 1985, s 184[2][a]). Comparatively, certain areas of jurisdiction in the United States (e.g., California) require that every individual involved in a conversation must provide consent (i.e., two-party consent; Robbins, 2017). Therefore, researchers should consider the laws in their specific region and engage in a collaborative relationship with their IRB to ensure all ethical concerns are addressed. Below, interested researchers can find some basic components of our IRB applications that have led to approvals at two Canadian universities.

Researchers should begin the recruitment process by hosting information sessions where individuals who may be recorded (e.g., athletes, parents, and coaches in a sport setting) are provided with an overview of the proposed research and given the opportunity to ask questions.

The consent forms should introduce the EAR method, explain how it will be implemented in the study, and require participants to opt-in to each component of the research (e.g., pre-/post-questionnaires, daily diaries, EAR). Together, these steps inform participants and their families of when EAR observations will occur, which negates the expectation of privacy during conversations around the EAR devices during the observation period. Once data collection begins, participants should be assigned pseudonyms to de-identify their data. These pseudonyms are relevant for programming the EAR software, as a "Participant ID" is imbedded in each audio observation downloaded from the device. All identifiable information should be securely stored offline and in a separate location from de-identified data (e.g., questionnaires). As suggested elsewhere (e.g., Robbins, 2017), researchers may find it helpful to keep a "Project Status Workbook" (i.e., Microsoft Excel spreadsheet) that tracks data collected and workflow status on data entry and analysis, organized by participant pseudonym. These recommendations help protect participants' privacy and confidentiality.

The collection of EAR audio recordings raises additional ethical concerns that require careful consideration. Researchers can manage concerns about participant privacy by selecting a sub-sample of consenting team members to participate in the EAR component of a study. This sampling strategy limits the amount of observational data from a specific group and lowers the risk of potential negative consequences for individuals who prefer not to wear an EAR device (e.g., peer pressure). Considering that researchers' access to EAR devices is also likely to be limited, distributing EAR devices across multiple teams may provide the opportunity to observe different experiences (e.g., one-on-one conversations, a coaches' pre-game speech) of the same event (e.g., a competitive tournament), while maximizing the number of participants available for other study components (e.g., questionnaires). In fact, we recommend that EAR observation

periods are purposely scheduled to coincide with training or competition to maximize the likelihood of capturing relevant conversations among teammates, coaches, and parents, and to minimize the likelihood of capturing irrelevant conversations involving non-consenting third parties. The amount of identifiable information collected during any non-consenting third-party conversation can be further limited by programming brief audio recordings (e.g., 50 seconds). Researchers interested in observing youth sport participants should also be aware of additional ethical approvals required from schools and school boards to conduct research in educational settings.

In relation to analyzing the EAR data, researchers should determine clear and specific inclusion criteria regarding which conversations meet the aims of the research. For example, we only retained conversations about team membership or sport participation that included team members (i.e., athletes, coaches) and/or parents for transcription and analysis (~85-90% of EAR recordings). It is also important that research assistants have protocols for reporting evidence of illegal activity and harming behaviours (e.g., child abuse, elder abuse, self-harm) to superiors for additional review. The legal obligation to relay evidence of a crime or abuse to authorities varies by area of jurisdiction and it is the investigator's responsibility to understand and follow the requirements that apply to their data collection. Investigators should also make their reporting requirements clear to participants in the study's consent form. All other conversations are permanently deleted at the earliest opportunity. Whereas all discernable conversation captured from the recordings that meet our inclusion criteria are transcribed, only dialogue from athletes, coaches, and parents on participating teams is coded using the ACSSES. Only researchers and research assistants who have signed an IRB approved confidentiality agreement and have undertaken the coder training program have access to the EAR data.

Limitations of the EAR Methodology

Even though the EAR method provides an innovative approach to explore social phenomena, several key limitations require consideration. First, the EAR cannot capture non-verbal behaviours that are important for contextualizing effective communication in other video behavioural observation methods (e.g., Allan et al., 2016). Another limitation is the cost associated with EAR research, such as acquiring devices (e.g., Android devices start at ~$60 CAD/device) and protective casing (~$20 CAD/case). Protective cases that include belt clips can enhance the audio quality of the recordings as participants will not have the devices in their pockets. Researchers may also want to consider purchasing wall ports (~$2 CAD/wall port) to ensure that participants have the necessary equipment to keep the EAR devices charged and functioning properly.

Collecting, organizing, transcribing, and coding EAR-derived audio recordings is a lengthy and laborious process. Once the EAR devices are collected from participants after the observation period, researchers must listen to audio recordings to determine which observations meet the study's inclusion criteria. For example, if six athletes and a head coach from eight youth sport teams (N = 56) each wear an EAR device programmed to record for 50 seconds, every 12.5 minutes, from 08:00-20:00 over a 3-day observation period, researchers will need to review and organize ~9,000 audio recordings. Once audio files relevant to the research question are identified (e.g., 10-15% of recordings or 900-1,350 audio files), researchers transcribe each audio file and add the transcripts to the coding instrument where trained coders analyze the data—this process may take 8 to 12 months.

The ACSSES also has key limitations that should be considered by researchers interested in using or building on the coding instrument. For instance, the ACSSES is limited to coding

interactions with head coaches, parents, and teammates. The current version of the ACSSES does not include categories that allow researchers to assess interactions with other key social agents (e.g., siblings; Blazo & Smith, 2018). In addition, the majority of the ACSSES *behaviour* codes were developed to assess assumed positive (i.e., supportive) and negative (i.e., aversive) relationships (Holt-Lunstad & Uchino, 2019). Holt-Lunstad and Uchino (2019) argue that researchers need to gain a better understanding of social relationships characterized by a mix of positivity and negativity (i.e., ambivalent relationships) and how they influence health-related behaviours (e.g., sport participation). Future research with the ACSSES could evaluate how to analyze the positive and negative behaviours captured with the EAR method to examine the influence of ambivalent relationships.

Future Application of the EAR Methodology in Sport

The EAR method and ACSSES provide sport researchers with a novel methodology to address research questions involving the observation of athletes and key social agents (i.e., teammates, coaches, parents) as they interact in settings outside of the immediate sport activity. Together, the EAR method and ACSSES can facilitate the assessment of a wide range of research topics (e.g., intragroup behaviour, leadership behaviour, social identification processes) and perspectives (e.g., athlete, coach, parent, official). Using the scenario involving Lydia, we now consider possible applications of the EAR to explore her identification with her new team.

Lydia's story provides a context with numerous research topics for investigators to choose from. Considering it is her first year with a new team, social identity may be a construct of interest. For Lydia, her integration into a new team would theoretically involve social identification processes in the form of interactions with her coach and teammates that would introduce her to the social identity content (i.e., the morals, values, and norms of the group;

Reicher, 1984) of the team. If the social identity content or the way it is introduced appeals to her, it would likely strengthen her identification with the team (i.e., social identity). Conversely, she may not agree with the social identity content based on existing beliefs or how the new information is presented, which could negatively affect her identification with the team. The EAR methodology could be used with Lydia, a sample of her teammates, and her coach over a period of time (e.g., tournament) to collect data about the interactions that influence team members' social identification. Following transcription of all conversations that discuss sport participation or team membership, trained coders would use the ACSSES to code the transcripts for relevant contextual information and behaviours present in the interactions. The behavioural frequency analysis could then be converted to represent a proportion of time spent engaged in conversations that include target behaviours of interest, and assessed in relation to other measures (e.g., pre-/post-questionnaires, daily diaries). The transcripts could also be qualitatively analyzed to determine how actual leader behaviours demonstrated by Lydia's coach aligned with the four Principles of Social Identity Leadership (Haslam et al., 2011). These analyses would provide new insights into social identification processes and how they relate to a variety of potential variables (e.g., moral behaviour, intentions to continue in sport, performance). This is one example demonstrating how the EAR could be used to observe participants daily experiences in ways that may have previously been difficult to undertake.

Conclusion

As smartphones and other wearable technologies become more imbedded in everyday life, so too do the opportunities for researchers to responsibly access real-world information as it unfolds (Miller, 2012). The ability to access social environments around sport where athletes, coaches, and parents interact can help advance our understanding of the important, yet complex,

social dynamics that exist. As Tamminen and colleagues (2017) noted, youth athletes indicate that private settings are where many valuable conversations related to their sport experiences occur. The application of the EAR method and development of the ACSSES affords new opportunities to examine temporal changes, behaviour, and daily processes that are associated with short- and long-term outcomes in sport.

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