



Interpersonal emotional influence in performance dyad relationships

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Abstract

Performance dyads compete and work in intense situations which can stimulate a wide array of emotional experiences. Nevertheless, the interpersonal emotional considerations of these performing partnerships have yet to be investigated in the literature. The aim of this research programme was to establish the extent to which performing partners experience interpersonal emotional influence through emotional contagion or other similar influential processes. In addition, factors affecting these interpersonal processes were examined. This thesis consists of four studies which each contribute to expanding our understanding of the influential effect of performing partners' emotional displays.

The first study (Chapter 2) was completed to develop, and initially validate, a brief emotion questionnaire that could be used in sporting contexts. A sample of both sport psychology experts and student athletes were used to create the 10-item emotion scale – the Brief In-Competition Emotion (BICE) Scale. Two further athlete cohorts were recruited in validation and feasibility assessments which presented evidence that the scale was effective at assessing athletes' in-competition emotions.

The BICE scale was then used in Chapter 3 to investigate instances of within-dyad emotional aggregation for doubles table tennis pairs competing collaboratively. Evidence of within-dyad aggregation was identified for Happiness and Dejection at an in-competition time point and for Happiness, Dejection and Anger at a post-competition time point. These findings presented the first evidence to indicate that sporting dyads experience interpersonal emotional convergence whilst competing.

The next investigation (Chapter 4), a laboratory study, explored factors affecting the olfactory-facilitated emotional contagion process for collaborative partners completing tasks. Although evidence had been presented to indicate that emotions can be transferred between individuals via body odours, no research had previously identified individual differences

which may affect this process. It was found that individual differences in the participants' attitude regarding the importance of their sense of smell affected the within-dyad emotional aggregation process. As a result, a factor affecting the extent to which performing dyads experience emotional contagion was identified.

The final study (Chapter 5) was a qualitative exploration of the interpersonal emotional experiences of ambulance service pairs whilst working shifts together. Recorded interviews and voice diaries uncovered self-reported instances of the Emotions as Social Information Model processes (Affective Reactions and Inferential Processes). Following retroductive analysis methods, factors affecting these processes were identified. This is the first time that within-dyad interpersonal emotional influence has been identified in emergency services dyads.

In sum, the findings from this programme of research showed that performance dyads experience processes indicative of the interpersonal emotional influence described by the Emotions as Social Information model. These influential processes were identified in performance dyads across two performance domains: sport and the emergency services. Additionally, factors affecting the prevalence of these social emotional processes were presented, and can subsequently be used to ascertain individuals, pairs and contexts where interpersonal emotional influence may be present. Further implications of this programme of research and additional future research are outlined in the general discussion (Chapter 6).

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Declaration

While registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

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Chapter 1: General Introduction

1. Introduction

The experience of an emotion is a brief, transient occurrence which can disappear with the removal of the stimulus (Sieb, 2013). Yet, despite being short-lived by definition, emotions can leave an enduring impact upon an individual and those in close proximity (Wagstaff & Tamminen, 2021). Van Kleef (2009) outlined the affective, cognitive and behavioural influence that emotional expressions can have on observers in his Emotions as Social Information (EASI) Model. This is an indication of the prominent role that social relationships play in the creation, transfer and development of emotions. For instance, observing a colleague's positive emotional display may lead one to feel happier, or a colleague witnessing you upset could result in them attempting to comfort you. Researchers therefore stress that the emotions that individuals experience when situated in groups, such as during sports or at work, do not occur in a vacuum as they are likely to impact, and be impacted by, interactions rooted in social scenarios (Tamminen & Bennett, 2017). Emotional contagion is defined as the transfer of emotion between individuals either consciously or unconsciously (Barsade et al., 2018). This emotional transfer is a key process described in the EASI model and contributes towards interpersonal emotional influence (Hatfield et al., 1994). Emotional contagion is facilitated by emotional displays which most commonly take the form of facial expressions, tone of voice or other behavioural gestures (Hatfield et al., 2009). As well as explicitly demonstrated emotional displays, implicit physiological factors such as body odour have also been shown to facilitate emotional contagion (see de Groot, 2017).

Emotional contagion is a well referenced concept within common wisdom. For instance, it may be said that a *smile is contagious* or that *panic can spread through a crowd*. The adoption of these common idioms implies that the interpersonal emotional transfer process is well evidenced in general life. Nevertheless, there is a lack of research

investigating the presence and facilitative factors of interpersonal emotional transfer in applied contexts.

The aim of the present thesis was, with two overarching goals, to investigate emotional contagion and interpersonal emotional influence in the contexts of sport and the emergency services. The first goal was to identify instances of emotional contagion and other interpersonal emotional influence in sport and ambulance service dyad relationships. The second goal was to subsequently examine and ascertain a range of facilitative factors that may impact upon the prevalence of these interpersonal emotional concepts in dyadic relationships. The studies described and explained in this thesis achieved these goals through a focus on the development of a new method of measuring emotion, as well as both quantitative and qualitative assessments of interpersonal emotional influence. This introductory chapter will outline the key literature surrounding emotional contagion and other processes of interpersonal emotional influence through the lens of the Emotions as Social Information Model (Van Kleef, 2009).

1.1. The Performance Dyad Relationship

A performance dyad is a relationship between two individuals who are linked by their shared aspiration for the same goal. Dyadic relationships can span a continuum of authority, ranging from coach-athlete or manager-subordinate relationships (Baral & Sampath, 2019; Mueller et al., 2018), to partnerships between athletes on the same team (Deck et al., 2021; Jackson et al., 2010) or work colleagues with parallel authority (Rodriguez-Munoz et al., 2020). Specifically, sporting dyads have been studied in table tennis (Greenlees et al., 2005), tennis (Lausic et al., 2009) and volleyball (Wickwire et al., 2004). Dyadic partners in sport take part in extensive communication during matches (Fritsch et al., 2020) and much of this communication can be identified as emotional in nature (Lausic et al., 2009). Nevertheless, the role that these emotionally charged, within-dyad communication instances play in leading

to interpersonal emotional concepts such as emotional contagion has not yet been investigated. Additionally, frontline ambulance service dyads also benefit from consistent within-dyad communication (Patterson et al., 2017) and they regularly express their emotions when placed in the emotionally intense scenarios inherent in their role (Drewitz-Chesney, 2019; Lowery & Stokes, 2005). Both sport and emergency services dyads therefore demonstrate consistent emotional interaction while competing/working together, possess close social bonds (Filstad, 2010; Wickwire et al., 2004) and experience high levels of emotion during competitions or shifts. These social contextual characteristics represent the necessary requirements for the socially influential, interpersonal emotional processes that are outlined in the Emotions as Social Information (EASI) model (Van Kleef, 2009) to occur.

1.2 The Emotions as Social Information (EASI) Theory

Emotions are privately experienced feelings which can have intrapersonal consequences and impact upon an individual's own behaviour and cognitions. Nevertheless, previous literature has, in part, tended to erroneously ignore the interpersonal effects of experienced emotions. As Van Kleef (2010) posits, "if emotions were only functional at the individual level, why would they show on our faces" (pp. 331). The act of displaying an emotion expressly highlights the socially communicative interpersonal function that exists for emotional experiences. Despite being individually experienced, emotions are outwardly displayed, and these displays may be observed by those individuals in close proximity. The Emotions as Social Information model (Van Kleef, 2009) outlines the processes and mechanisms through which an individual's emotional displays can influence the affective, cognitive and behavioural reactions of those around them. The EASI model presents two processes which can be used to clarify how an individual's emotional displays may impact an observer. These two processes are Inferential Processes and Affective Reactions.

First, the EASI model explains that emotional displays can cause interpersonal influence through prompting Inferential Processes in observers (Van Kleef, 2009). Observers may use an individual's emotional expression to infer information related to that individual's attitudes, intentions or emotions (Van Kleef & Fischer, 2017). For instance, an employer expressing anger towards an employee may lead the employee to infer that the employer is unimpressed with the quality of their work or their general work performance. Similarly, a stand-up comedian can infer from the audience's laughter that they are enjoying the jokes. The information conveyed to observers through emotional displays can be categorised into inferences related to the situation, inferences related to the expresser, and inferences related to the self (Van Kleef & Cote, 2022). For example, an observer may use others' expressions of anger to infer a number of different social aspects, such as the common norms in social situations (Hareli et al., 2013), an expresser's strong and ambitious nature (Van Dijk et al., 2008), or to infer an expressers' emotions towards them (Van Kleef et al., 2019). Each of these examples highlight the wide range of influence an individual's emotional displays can have upon observers' perceptions of social situations. Inferential Processes can also elicit behavioural changes in observers partly as a result of their inferences. These behavioural reactions could involve the demonstration of interpersonal emotional regulation.

Interpersonal emotional regulation is the act of deliberately managing another's emotional state (Zaki & Williams, 2013). An observer may identify an expresser's emotional state through their emotional displays and subsequently choose to regulate that emotion for the benefit of themselves, the expresser or others (Friesen et al., 2013). Evidence for interpersonal emotional regulation has been found within sports teams (Tamminen & Crocker, 2013) and organisational contexts (Niven, 2016).

The second process through which emotional displays can cause interpersonal influence is Affective Reactions. Affective Reactions describe processes whereby an

expresser's emotional displays can trigger emotional changes in an observer which can then influence their behaviour and cognitions (Van Kleef, 2010). The interpersonal influence caused by Affective Reactions can, at times, impact observers' impressions and affection for the emotional expresser (Van Kleef, 2009). For example, it has been shown that simply observing others' expressions of happiness increases interpersonal liking while observing expressions of anger decreases liking (Clark & Taraban, 1991). The positive effect that positive emotional displays can have on observer sentiments has been evidenced within the service industry (Tsai & Huang, 2002) and organisational contexts (Van Kleef et al., 2009). As well as influence on interpersonal impressions and sentiments, the EASI model process of Affective Reactions also includes interpersonal emotional transfer, which is a key focus of this thesis.

1.3 Emotional Contagion

The interpersonal emotional transfer literature pertains largely to emotional contagion, the conscious and unconscious transfer of mood and affect through a group (Barsade, 2018). The Barsade (2018) definition includes reference to both conscious and unconscious emotional transfer and develops upon the Hatfield et al. (1993) definition which described emotional contagion as a solely unconscious process. Unconscious emotional contagion, also known as primitive emotional contagion, comprises an interpersonal emotional association and transfer which occurs with an automaticity below detection. Facilitators of this process may include mimicry and synchrony in facial expressions, postures and tone of voice (Hatfield et al., 2014), as well as a role for physiological facilitators such as olfaction (de Groot, 2017). For instance, mimicking a smiling face has been found to lead observers to feel happy through a physiological feedback process (Hatfield et al., 2014). Conscious emotional contagion, although resulting in the same emotionally convergent outcome, occurs predominately through social comparison processes. Individuals observe an expresser

displaying a certain emotion and use that emotional display information to inform an appropriate emotional response (Kelly & Barsade, 2001). As expresser emotional displays are also required for conscious emotional contagion to occur, facilitators such as tone of voice, gestures and facial expressions are just as relevant for this conscious process. Interestingly, although presented as separate processes by Barsade (2018), evidence of both the conscious and unconscious emotional contagion processes collaboratively causing emotional association in social situations has been presented (Parkinson & Simons, 2009). This would indicate that these processes are not distinct and in fact can both combine to facilitate interpersonal emotional association.

Emotional aggregation and emotional convergence are two terms used within the literature to outline and explain concepts related to the processes of emotional contagion. Emotional convergence describes the tendency for the emotions of two or more individuals to become more alike over a period of time (Zablah et al., 2017). Emotional aggregation has not been defined within the literature, although in this thesis, the term refers to a collective, group emotional state consisting of suitably similar individual group members' emotions acting as component elements. As such, group emotional aggregation relates to a measurement taken at a single time point, while evidence of emotional convergence requires a group's emotional similarity to increase over time. Both emotional aggregation and emotional convergence necessitate the demonstration of emotional contagion.

1.3.1 Measuring Emotional Contagion

Assessments of emotional contagion have changed as the literature has developed and philosophical approaches to the concept have transformed. Initially, emotional contagion was assessed solely as an individual trait characteristic using the Emotional Contagion Scale (Doherty, 1997). Such trait susceptibility scales are now more commonly used as individual difference measures rather than as measures of emotional contagion (Barsade et al., 2018).

For example, the Contagion of Affective Phenomena Scale (CAPS; Clarkson et al., 2021) is used in this thesis to measure athletes' trait susceptibility to experiencing emotional contagion.

Instead, emotional contagion is now more frequently assessed using assessments of emotional aggregation taken from multiple emotion measurement time points (see Liu et al., 2019; Sy et al., 2005; Totterdell, 2000). This method allows for any changes in participant emotion to be tracked and for any interpersonal emotional transfer to be more easily identified. Advanced statistical techniques such as multilevel modelling can also be employed which can account for group level variance in the measurement of individual emotional states and provide further statistical evidence for interpersonal emotional transfer and aggregation. In order for these emotion measurement methods to be successful, the utilised emotion measurement scale needs to be valid and feasible for use in the contexts required. For instance, any measurement scale which aims to assess emotion during sporting competition would need to be both valid for use in sport and practical for administration in time sensitive situations (Campo et al., 2018; Horvath & Rothlin, 2018). Currently, no such measure exists, which highlights the issues researchers face when attempting to accurately investigate emotional contagion in specific domains.

Researchers have also begun to assess emotion in emotional contagion studies using physiological emotional indicators such as skin conductance (Knight & Barsade, 2013) and heart rate (Park et al., 2019). These investigations represent an exciting progression in emotion measurement and further validation and feasibility assessments of these methods are encouraged, but not undertaken in this thesis.

1.3.2 Evidence of Emotional Contagion

Evidence of emotional contagion has been presented across a range of domains using varied research methodologies. These investigations differ; some using laboratory-based

experimental designs and some using more natural applied examinations of the concept. A key emotional contagion study undertaken by Barsade (2002) used an experimental design to assess the contagious effect of trained confederates' emotional displays on participants taking part in a managerial negotiation task. Barsade (2002) found evidence of emotional contagion in this context for both the transfer of positive and negative emotions. These findings indicate that the emotional contagion process can act as both a hindrance (negative emotions) and a benefit (positive emotions) to teams owing to the differing effects of collective positive and negative emotions (Campo et al., 2019). Similar laboratory studies have further identified the transfer of emotion in collaborating participant groups (e.g., Bartel & Saavedra, 2000; Hennig-Thurau et al., 2006; Sy et al., 2005). Emotional contagion has also been examined in applied contexts, often using the aforementioned emotion questionnaire methods. For example, evidence of emotional contagion and aggregated emotional states have been identified in military groups preparing for collaborative tasks (Knight, 2015), employees in care facilities (Barsade & O'Neil, 2014), and business teams working in automotive manufacture (Cole et al., 2008) and research and development (Tsai et al., 2012). Each of these studies conducted assessments of the participants' emotions and used a relevant statistical method (such as r_{wg} agreement values, Tsai et al., 2012) to measure the extent of emotional aggregation present in these contexts.

1.3.3 Emotional Contagion in Sport

Despite the important role that *individual* emotional experiences have in affecting sporting performance (Hanin & Ekkekakis, 2014), there has been a lack of investigation into the presence and impact of collective emotions and interpersonal emotional transfer in sport teams. In their qualitative explorations of team performance collapses, Wergin et al. (2018) and Cope et al. (2010) discussed the existence of contagious spreading of negative emotions when teams start to perform badly. Often this spread is initiated and facilitated by one

individual with a particularly detrimental and negative attitude (Wergin et al. 2019). Sport psychology researchers have also identified the contagious nature of coaches' and leaders' emotions when in the proximity of their players. In baseball, softball and soccer, leader displays of happiness and anger both during matches and at the half time interval were found to predict their players' happiness and anger (Van Kleef et al., 2019). Emotional contagion was used to explain these convergent emotional relationships, although the adopted methodology does not directly identify causality and directionality. Van Kleef and colleagues' findings highlighting the contagious effect of sport leaders' affect, are supported by similar evidence presented by Cotterill et al. (2020). Emotional experiences have also been shown to spread between teammates through outward emotional displays. Moll et al. (2010) found evidence that soccer players who took a penalty kick after their teammate exhibited positive emotional displays following a successful kick, were more likely to score their own penalty. It was argued that the positive impact that the teammate's celebratory behaviour had on the kicker occurred, in part, as a result of emotional contagion and interpersonal emotional influence. Further, soccer players' post-match emotional states have been shown to be significantly related to the collective post-match emotions of their team (Rumbold et al., 2021), indicating a post-match within-team emotional aggregation. Interestingly, in this instance, the soccer players' negative emotions were found to aggregate to a greater extent than the positive emotions. Rumbold et al. (2021) posited that this finding occurred as a result of the ease and strength with which one can express negative emotions, such as anger, compared to displays of positive emotions, although this argument is not fully supported. This evidence of both positive and negative emotional aggregation advances previous work from Totterdell (2000), who found only a positive emotional aggregation for cricket players in the same team while they competed in matches. Totterdell (2000) showed that the athletes' positive mood was significantly related to that of their teammates' during

their 4-day match. It was proposed, owing to the adopted time series regression statistical approach, that this within-team emotional association occurred solely because of social phenomena rather than simply the athletes individually experiencing the same emotion in relation to the same events. Despite only finding evidence of positive affective association, the Totterdell (2000) study remains the only inter-teammate investigation of emotional contagion which uses an in-competition emotion assessment method. Relevant here, is the fact that cricket allows for an easier collection of in-competition emotion data owing to long stoppages in play and players waiting to bat for extended periods of time. As a result, there continues to be a lack of research examining the presence of interpersonal emotional transfer in fast paced sports with fewer breaks in play.

1.3.4 Emotional Contagion in The Ambulance Service

Success in sport requires similar personal and collective skills and attributes to those that are also reflected in other performance domains. For instance, the emergency services consist of teams striving towards clear performance goals related to patient care. The role of paramedics and other frontline ambulance staff can be extreme and demanding which results in complex emotional environments (Brewis & Godfrey 2019; Granter et al., 2019).

Therefore, as well as the teamwork and personal performance considerations inherent in sports teams (Travers, 2018), success in specifically the ambulance service can also be impacted by the emotional management and experiences of the situations in which ambulance service employees find themselves (Lowery & Stokes, 2005). Ambulance service staff must communicate well with their frontline dyad partners (Patterson et al., 2017) and, owing to the emotional events that they experience, these communication instances are highly emotionally expressive (Drewitz-Chesney, 2019). The exhibition of emotional displays in these instances may subsequently lead to the presentation of interpersonal emotional influence processes, such as emotional contagion, outlined in the EASI model (Van Kleef, 2009). Nevertheless,

researchers have not previously examined ambulance service pairs' experiences of emotional contagion. Yet, in the healthcare system, Totterdell et al. (1998) found evidence of nurses' individual emotions presenting significant associations with their team's collective emotional state. Totterdell et al. (1998) also showed that those nurses who exhibited more commitment to the team and perceived a better team climate experienced a stronger emotional association to the rest of the team. Evidence from nursing and other related domains would suggest that ambulance service dyads may also experience interpersonal emotional transfer when working together. Further, the close bonds that ambulance service pairs experience (Filstad, 2010) and the extended periods of time that they spend in each other's company (Clompus & Albarran, 2016) help to promote instances of emotional exhibition and display.

1.3.5 Olfaction and Emotional Contagion

Chemosignals, chemicals in human bodily secretions, are key physiological facilitators of emotional contagion (De Groot et al., 2017). These secretions can be found in human body odour and can relay emotional information from one individual to another (de Groot et al., 2012). The processing of social emotional chemosignals is thought to take place in brain areas associated with the processing of social information (Lundstrom et al., 2008; Prehn-Kristensen et al., 2009). Lundstrom and Olsson (2010) proposed that body odours are given a processing priority within the brain as a result of social body odours carrying more pertinent information than common odours. This allows for quicker processing and responses, thus affecting the speed of reactionary behaviour or the distribution of attentional resources.

Researchers have found that participants can distinguish between happy, fearful and control body odours (Chen & Haviland-Jones, 2000). These findings provide evidence to suggest that body odours contain an identifiable chemosignal profile which differs across differently experienced emotions. The unconscious detection of these emotional

chemosignals has been shown to enable the interpersonal transfer of both positive (de Groot et al., 2015) and negative emotions. For example, evidence of fear and anxiety contagion through olfactory means has been presented using the demonstration of increased participant startle responses (Prehn et al., 2006), state anxiety measures (Albrecht et al., 2011), fMRI brain activation (Mujica-Parodi et al., 2009) as well as other measures (Dalton et al., 2013; Haegler et al., 2010; Zernecke et al., 2011). A study by Singh et al. (2018) found that the effect of anxiety-linked body odours on receivers' emotional states was also demonstrated when using more applied methodologies. Singh et al. (2018) presented body odours from anxious donors to dental student participants using a doused t-shirt worn by a practice dental mannequin. The dental students performed significantly worse in dental procedures when exposed to these anxious body odours compared to non-social control odours. The applied task performance measure utilised in Singh and colleagues' study provides an ecologically valid example of the role that olfactory chemosignal detection can play in real world scenarios and shows that using a more natural odour presentation can still lead to the detection of body odours and the subsequent emotionally contagious effect. Singh et al. (2018) highlight that the rigorously controlled presentation methods used in previous studies (see Albrecht et al., 2011; Prehn et al., 2006) are not required to investigate olfactory facilitated emotional contagion. As a result, olfactory facilitated transfer can be assessed in performing contexts and may impact upon the emotional relationships present in applied performance dyad domains.

Despite extensive evidence for the role of the olfactory system in unconscious emotional contagion, the factors affecting this process are largely yet to be explored. Evidence has been presented to show a relationship between individuals' olfactory identification performance and the higher order executive functioning required for emotional contagion to occur (Hedner et al., 2010). Hedner et al.'s (2010) findings, coupled with the

link between emotion and olfaction (Pollatos et al., 2007; Stafford & Wellbeck, 2011), raise the possibility that an individual's olfactory functioning ability may affect their tendency to experience interpersonal emotional transfer and aggregation. In addition, psychometric measures that relate to social odour may also help identify a tendency to experience olfactory facilitated emotional contagion. The Importance of Olfaction questionnaire (Croy et al., 2010: IOQ), which measures individuals' attitudes towards their own olfaction, includes items which assess the use of odour and olfaction in social situations, for example 'The smell of a person plays a role in the decision as to whether I like him/her' and 'If my partner has a nasty smell, I avoid kissing them'. IOQ scores have been shown to correlate with social communicative factors such as an individual's tendency to exhibit socially conforming behaviours (Seo et al., 2013), and an increased odour detection rate has also been associated with an increase in social odour awareness (Sorokowska et al., 2018). As a result, measures of olfactory attitudes which reference odour in social situations may also be found to indicate individuals' susceptibility to experiencing olfactory facilitated emotional contagion.

1.3.6 Social and Contextual Factors Influencing Emotional Contagion

Researchers have identified social and contextual factors which can impact upon the tendency for interpersonal emotional transfer to occur in social situations. Both primitive and conscious emotional contagion rely heavily on outward emotional expressions in order for observers to identify the expresser's emotion. As a result, the intensity of the expression can impact the likelihood that an expresser transfers an exhibited emotion to an observer (Hatfield et al., 2014). In addition, Van Kleef (2010) outlined the role that the depth of processing has in causing emotional contagion. Van Kleef stated that a shallower level of processing is more likely to lead to Affective Reactions, such as emotional contagion, while deeper processing may cause emotional reactions more akin to Inferential Processing. It was theorised that this occurs because Affective Reactions often occur faster and with less

conscious consideration. Moreover, it has been shown that Affective Reactions, such as emotional contagion, are more likely to occur for collaborating group members, while it is more common for Inferential Processing to occur between opposing groups (Moll et al., 2010; Van Kleef et al., 2004). Van Kleef et al. (2004) explain that any emotional contagion that can occur between opposing individuals may be overruled by strategic considerations, which is more likely to lead to an emotional mismatch rather than convergence. Individual differences in emotional intelligence and emotional detection ability have also been found to affect the mechanisms required for emotional contagion (Neves et al., 2018). These findings support the theory that emotional contagion susceptibility questionnaires, which also assess an individual's emotional attention and responses, can successfully identify those individuals who are more likely to partake in interpersonal emotional transfer. Kimura et al. (2008) presented evidence to suggest that a higher degree of intimacy in a relationship is also more likely to lead to emotional contagion following emotional displays. Undergraduate students' emotions were assessed after being told an intensely positive or intensely negative story by either a friend or an acquaintance. The emotional responses reported by these students were significantly stronger in the friend condition when compared to being told the story by an acquaintance (Kimura et al., 2008). Nevertheless, Hatfield et al. (2014) reported mixed findings regarding the strength of social relationships and in-group factors in affecting emotional contagion susceptibility. Although some evidence suggests that social relationships can influence emotional contagion (Aylward, 2008; Hess & Fischer, 2013), Hatfield and colleagues were not able to replicate these findings using multiple investigative techniques. Moreover, no study has identified factors specifically affecting instances of emotional contagion and interpersonal emotional influence in performance domains such as sport or the emergency services.

1.4 New Research Directions

The present thesis draws upon a far-reaching and varied literature base in order to advance the field of interpersonal emotional influence with a key focus on emotional contagion. There is a distinct lack of emotional contagion research within in-competition sporting contexts, especially when studying the transfer of emotions between teammates. Despite evidence of emotional aggregation in cricket teams (Totterdell, 2000), and theoretical support in soccer teams (Moll et al., 2011), no researcher has considered the presence of emotional contagion in other team sport contexts, such as smaller teams (i.e., dyads), or teams that compete on the field together continuously during competition. Sport dyads benefit from strong emotional relationships (Friesen et al., 2013) and demonstrate consistent emotional communication (Poizat et al., 2009), therefore, it is likely that the necessary social and contextual characteristics are present in these relationships for interpersonal emotional transfer to occur. Evidence of emotional contagion in competing sport dyad relationships would assist researchers in expanding the social emotional literature in sport.

The most common method used to study emotional contagion in applied domains requires the administration of multiple emotion measures, however, there are currently a number of practical, and methodological, issues hindering the assessment of emotion in-competition. Assessing athletes' emotions in-competition requires a time sensitive approach that can allow for quick and easy measurement. To date, no sport specific emotion questionnaire is either valid for specific in-competition measurement or brief enough for practical in-competition study. As a result, in order for dyadic athletes' emotions to be assessed in-competition, a new sport specific brief emotion questionnaire needed to be developed and validated.

As well as in a sporting context, performance dyads can be found in the emergency services, where two emergency services staff members strive towards a shared goal (Hughes et al., 2017). This is clear in the ambulance service in which two frontline staff members

work together on the same ambulance. Researchers have not previously explored the presence of interpersonal emotional concepts in these dyadic ambulance service relationships, although, similar to the sport domain, both members of ambulance crews find themselves exposed to the social contexts required for interpersonal emotional influence (Clompus & Albarran, 2016; Drewitz-Chesney, 2019). Identifying the presence of interpersonal emotional influence in ambulance service dyads will lead to a greater understanding of their work processes and the effect that the two individuals' emotions can have upon their shared experiences. To date there has yet to be any in-depth exploration of the social emotional experiences of ambulance service personnel on shift, and as such, any investigation of these processes should include reference to both the EASI model Affective Reactions, such as emotional contagion, as well as Inferential Processes. Identifying evidence of either of these processes would be a unique addition to the literature.

As well as the identification of interpersonal emotional influence, principally emotional contagion, in the two domains of interest (sport and the ambulance service), this thesis will also aim to identify factors which can influence the prevalence of these processes. First, as discussed above, the olfactory system has been found to facilitate emotional contagion, nevertheless, little research has been conducted to identify individual differences and contributory factors for this process. Haviland-Jones et al. (2016) showed that participants varied in their ability to categorise explicit social odours. These findings suggest that there may be variance in individuals' susceptibility to experience olfactory facilitated emotional contagion. If personal differences related to one's olfactory system are identified as factors impacting olfactory facilitated emotional contagion, then individuals can be recognised as predisposed to being more susceptible to the effects of interpersonal emotional transfer.

Further, social and situation contextual factors affecting the presence of interpersonal emotional influence in performance relationships, specifically the emergency services, have also not been presented within the literature. Although researchers have demonstrated evidence that the intensity of an emotional expression (Hatfield et al., 2014), the relationship intimacy between the sender and receiver (Kimura et al., 2008) and the situational social norms (Tamminen & Crocker, 2013) may impact the tendency for interpersonal emotional influence processes to occur, these investigations have not focused on emergency services relationships. Ambulance service frontline pairs work in an important role striving to save lives each day, therefore, a better understanding of their emotional relationships may aid in improving their performance through a more considered approach to their social relationship.

1.5 The Current Thesis

There were three main objectives for this thesis. First, to develop a valid and practical emotion questionnaire relevant for assessing athletes' emotions in-competition. Second, to identify instances of interpersonal emotional influence in the dyadic relationships found in two performance domains (sport and the ambulance service). This included investigating specifically emotional contagion in sport dyads and, owing to a dearth of interpersonal emotional research within an emergency services context, investigating any social emotional influential processes in ambulance service dyad relationships. Third, to identify individual differences and factors which can facilitate and impact the interpersonal emotional influence processes identified in collaborative performance dyad relationships.

A mixed-methods approach was used to investigate these aims. Chapter 2 outlines the development and validation of a new brief in-competition emotion questionnaire (the BICE scale). Chapter 3 describes a longitudinal survey approach to assessing within-dyad emotional convergence in doubles table tennis matches. Chapter 4 outlines a laboratory study in which the effect of olfactory functioning on instances of emotional aggregation is assessed,

in an effort to identify individual differences in the olfactory-facilitated emotional contagion process. Finally, Chapter 5 is a study that used qualitative methods to explore evidence of EASI model interpersonal emotional influence in ambulance service dyads, and then retroductive analyses to identify contributory factors affecting the tendency for these interpersonal emotional concepts to occur. Chapter 6, the general discussion, includes a summary of the main findings of this novel line of enquiry and highlights the beneficial, applied implications of all of the presented findings.

Chapter 2: Development and Validation of an In-Competition Emotion Measure: The Brief In-Competition Emotion (BICE) Scale

This chapter draws from the following manuscript:

Freemantle, A.W.J., Stafford, L., Wagstaff, C.R.D., Akehurst, L., & van Laar, D. (2021).

Development and validation of the Brief In-Competition Emotion scale: The BICE scale. *Psychology of Sport and Exercise*, 57(11), 102050.

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2.1 Abstract

The aim of this study was to develop a concise psychometric scale to assess athletes' in-competition emotions, which would reduce the practical and conceptual limitations of previous measures. Four studies were designed to develop and assess the validity of the new Brief In-Competition Emotion (BICE) scale. In Study 1, the content validity of 39 emotion adjectives was investigated using expert analysis, 9 adjectives were subsequently removed. In Study 2, 402 university athletes used the remaining 30 adjectives to record their in-competition emotions and confirmatory factor analyses and a reliability removal method was used to create the 10-item BICE scale. Study 3 (N = 109) and Study 4 (N = 74) consisted of both concurrent and predictive validity assessments of the BICE scale. Construct validity, reliability and confirmatory factor analyses completed during Study 1 and Study 2 resulted in the development of the 10-item BICE scale, consisting of five composite emotion factors: anger, anxiety, excitement, dejection and happiness. The findings from Study 3 and Study 4 showed that the BICE scale presented acceptable levels of concurrent and predictive validity. The BICE scale is a rigorously developed parsimonious scale which offers researchers new opportunities for investigation and provides applied practitioners with a new method of evaluating in-competition intervention efficacies.

2.2 Introduction

Research has shown that an athlete's emotions can have a major impact upon their success in sporting competitions (see Hanin & Ekkekakis, 2014 for a summary). This effect has been highlighted by researchers assessing athletes' pre-competition (Brandt et al., 2016; Samełko & Guskowska, 2016), in-competition (Allen et al., 2013; Martinent & Ferrand, 2015; Totterdell, 2000; van Kleef et al., 2019) and post-competition (Kerr & Males, 2010) emotional states. A prominent methodology in these instances has been the use of self-report questionnaires. Nevertheless, a concise, practical questionnaire to effectively assess the in-competition emotions of athletes does not currently exist. In this article, four studies are presented which contributed to the development and initial validation of a scale to assess athletes' subjective in-competition emotions. Here athletes' emotions are defined as brief, discrete subjective experiences specifically caused in response to an event related to sport (Lazarus, 2000; Wagstaff & Tamminen, 2021). In this research, "in-competition" refers to any time-point between the start of a competitive event and the end of that event. These instances could include cases such as during the 80 minutes of a rugby match, the twelve rounds of a boxing match or between the first and last attempt of a field athletic event. The aim of this scale is to assist in the collection of emotion data during time-sensitive situations and to offer a contribution to the literature by providing a more reliable assessment of athletes' in-competition emotional experiences.

2.2.1 Current Emotion Measures

Questionnaires offer a simple technique to ascertain the subjective emotional states of many athletes simultaneously. The ease of the self-report method has led to the development of numerous emotion-related questionnaires for use within sporting contexts (see for review, Lane et al., 2012). Although conceptually related, mood differs from emotion in that moods are typically longer lasting and created by lower intensity stimuli (Wagstaff & Tamminen,

2021). Affect is a summative term used to refer to both mood and emotion (Forgas, 1995). Many of the questionnaires frequently used in the literature to assess athletes' emotions, are in fact measures of mood, yet, in this research, the aim was to develop a scale relevant to specifically emotional measurement. Typically, a small number of measures have been used to investigate the moods and emotions of athletes, such as: the Profile of Mood States (POMS; McNair et al., 1971), the Profile of Mood States-Adolescents, also called the Brunel Mood Scale (POMS-A/BRUMS; Terry et al., 1999), the Positive and Negative Affect Scale (PANAS; Watson et al., 1988) and the Sport Emotion Questionnaire (SEQ; Jones et al., 2005). These scales have afforded valuable opportunities to undertake affect measurements pre- and post- competition, however, limitations exist concerning their use in assessing athletes' emotional states in-competition (Ekkekakis & Petruzello 2000; Lane, 2007).

The Profile of Mood States (POMS) is a commonly used scale within the field of psychology and was developed to assess the moods of psychiatric patients. Owing to the comprehensive collection of affect adjectives utilised within the POMS, the scale has been used in multiple studies to measure mood (at times labelled as emotion) among athletes (e.g., Hoover et al., 2017; Samełko & Guskowska, 2016; Szczepaniak & Guskowska, 2016). Nevertheless, following concern over the POMS accuracy in assessing specifically athletes' moods (LeUnes & Burger, 2000; Prapavessis, 2000), Terry et al. (1999, 2003) developed the POMS-A, later named the Brunel Mood Scale (BRUMS), as a sport specific alternative which still used items solely from the original POMS longlist. Although validated in sporting populations, some researchers maintain that the BRUMS is limited for use within sport owing to the clinical foundations of the original POMS (Jones et al., 2005). For instance, the BRUMS is heavily focused on negative moods, however, Grove and Prapavessis (1992) and LeUnes and Burger (2000) have criticised the utility of largely negatively oriented instrument designs for use within sport as athletes tend to experience both positive and negative affect to

similar extents (McCarthy, 2011). Moreover, Jones et al. (2005) argued that the face validity and efficacy of the BRUMS may suffer as a result of the inclusion of the items fatigue, confusion and depression which may not be seen as relevant to sport (see also Nicolas et al., 2019). In contrast to the POMS and its derivatives, the Positive and Negative Affect Scale (PANAS) utilises an emotional cross-valence approach with 10 positive items and 10 negative items. A short form version of the PANAS, the I-PANAS, which features 5 positive and 5 negative items has also been developed (Thompson, 2007). Despite considerable use within sport (e.g., Martinent & Nicolas, 2016; Samełko & Guszowska, 2016), the PANAS, and therefore the I-PANAS, are perhaps of a similar limited utility as the POMS within sporting contexts, owing to the use of non-sporting samples in the development and validation process (Ekkekakis & Petruzzello, 2000) for these scales. Additionally, it could be argued that the PANAS items such as interested, attentive and distressed, may not be commonly experienced by athletes whilst they are competing. Some researchers within sport have used single item assessment methods to assess a global affective dimension (e.g., Stanger et al., 2013). Nonetheless, these types of measures have been shown to suffer from statistical limitations, can be less reliable and at times are not sufficiently validated before use in sport (Ekkekakis, 2012; McCarthy, 2011). The single item emotion assessment method used in Doron and Martinent (2016) adopted a definitional approach which specifically listed items from the PANAS. The use of this PANAS-based definition is likely to lead to the same validity issues as when using the full PANAS scale.

2.2.2 The Sport Emotion Questionnaire

In light of the above limitations, Jones et al. (2005) developed and initially validated the Sport Emotion Questionnaire (SEQ) using an athlete-grounded four-stage process. Five theoretically supported factors, excitement, happiness, anger, anxiety and dejection, were selected to form the SEQ latent factors. Each factor was included as it had been shown to be

present within the self-reported emotional experiences of athletes and to be predictive of performance or similar outcome measures. For instance, the experience of happiness and excitement, the two positive SEQ latent factors, have both been shown to be beneficial to performance (Rathschlag & Memmert, 2015; Vast et al., 2010). However, the relationships between negative emotions included in the SEQ and sporting performance are less clear. Traditionally, researchers have suggested that experiences of anger have a negative effect on sporting performance (Lane & Terry, 2000). However, Woodman et al. (2009) have presented evidence of the benefits of experiencing anger when competing. Researchers have shown that this may be because anger causes an increased generation of energy targeted at the attainment of a task (Robazza & Bortoli, 2007; Ruiz & Hanin, 2011). Anxiety has been found to have a negative effect on performance (Judge et al., 2016), although this impact can be improved through effective regulation (for a review see Wagstaff et al., 2012). Dejection will often cause a decrease in the capabilities of sport performers owing to the associated arousal depletion (Lane et al., 2001).

Researchers (e.g., Allen et al., 2013; Vast et al., 2010) have used the SEQ to assess athletes' subjective within-game emotions. Yet, Jones et al. (2005) cautioned that the use of the SEQ in these instances is inappropriate as the tool was validated for the assessment of pre-game emotions. In addition, due to the time constraints of completing the 22-item scale, Allen et al. (2013) and Vast et al. (2010) had to rely on the potentially inaccurate post-competition emotional recall method (Hetland et al., 2018). As a result of these limitations, it does not appear practical for athletes to complete the SEQ in-competition and, it is also probable that many of the 22 SEQ items will not be relevant for measuring specifically in-competition emotions.

Measuring athletes' emotional experiences during competition offers researchers a unique insight into these previously underexplored emotional states, an insight which pre-

and post-competition approaches cannot provide. As suggested by Campo et al. (2019), solely pre-competitive emotion measurement removes the opportunity to study athletes' transitory emotional states and the effect that competition features, such as half-time breaks, have upon this affect. There is a need to undertake more context specific, in-competition assessments of athlete emotion so as to examine the impact of athletes' ongoing and transient emotional states on continual athletic performance (Campo et al., 2018). Nevertheless, the environments within which researchers aim to collect in-competition sport emotion data present practical issues. Typically, athletes do not have the time, or in some cases the inclination, to complete arduous questionnaires during a game or at an official break in play (Horvath & Rothlin, 2018). Presently, only two studies have successfully measured athlete affect within competition. First, Totterdell (2000) used the PANAS to measure cricket players' in-competition mood states. Relevant here, is the fact that cricket allows for easier collection of in-competition affect data owing to long stoppages in play and players waiting, for extended periods of time, to bat. Similarly, van Kleef et al. (2019) advanced the literature by assessing the emotional experiences of soccer players during matches by asking participants to complete emotion measures at half-time. However, van Kleef et al. (2019) did not use a validated psychometric emotion measurement scale. The development and validation of a parsimonious emotion measure that can be completed more readily during short competition intervals, will help to increase the strength and depth of the literature examining athletes' emotions across a range of sports and competition time-points. Moreover, a brief scale will allow for multiple measurement instances throughout competition and therefore enable and encourage longitudinal investigations of athletes' in-competition emotions.

As well as the academic advantages, the applied sport psychology domain will also benefit from a valid in-competition emotion questionnaire. The proposed measure (the Brief

In-Competition Emotion, BICE, scale) can be used to assess the specific in-competition emotions that athletes experience, to allow sport psychology professionals to develop behavioural interventions and assess intervention effectiveness with an accuracy that is not currently possible. In addition, a shorter measure could alleviate athletes' negative responses to questionnaire completion and allow practitioners to better engage their athletes in emotion measurement and wider psychometric assessment (Horvath & Rothlin, 2018).

The objective of the subsequent four studies was to develop and consequently assess the validity of a new in-competition emotion questionnaire. Study 1 aimed to use expert analysis to ensure that the item list was relevant and valid, Study 2 utilised the experiences of athletes to develop the 10-item scale, and Study 3 and Study 4 aimed to assess the validity of the newly developed questionnaire.

2.3 Study 1: Expert Analysis and Initial Item Selection

In line with recommendations for scale development (Carpenter, 2018; Hardesty & Bearden, 2004), an expert panel was used in Study 1 to assess the content validity of the proposed emotion items so as to exclude any items that may not be pertinent to an in-competition context.

The development process of the aforementioned Sport Emotion Questionnaire (SEQ; Jones et al., 2005) began with the compilation of a comprehensive list of emotion adjectives curated using relevant literature and athletes' experiences. This compiled list was grounded in the context of sport and focused specifically on short-term emotions rather than the longer-term moods of athletes, with the aim of avoiding some of the conceptual problems associated with other affect measures (Jones et al., 2005). Following two stages of rigorous item deletion and face validity assessments, the SEQ item list was reduced to 39 sport specific emotions which were each found to load onto one of five theoretically and statistically supported latent factors: anger, anxiety, happiness, excitement and dejection. At this stage of

the SEQ development process, this initial 39 emotion adjective list represented a valid and reliable indication of the emotions that athletes experience at all stages of competition: pre-competition, in-competition and post-competition. It is worth noting that whereas the final (22 item) SEQ was developed for *pre*-competition emotional states, I was specifically aiming to develop a measure which could be used to assess emotion for an *in*-competition context. For this reason, it was not possible to undertake a simple scale reduction process of the SEQ to develop a brief in-competition emotion scale. On that basis, the original SEQ broader (39 item) list, relevant to all sport competition timepoints, was utilised as the initial item list in our in-competition emotion measure creation process (see Table 2.1). In contrast to the intentions of the authors of the SEQ, the aim of this study was to develop a measure which could be used to assess emotion for a specifically in-competition context, as a result, the employed methodology differed from that of Jones et al. (2005) hereafter.

Table 2.1*The Initial Item List of 39 Items Procured from the Sport Emotion Questionnaire**Development Procedure*

Item	Item
Excited	Cheerful
Anxious	Upset
Fulfilled	Furious
Unhappy	Content
Charged	Exhilarated
Dejected	Frustrated
Nervous	Pleased
Daring	Joyful
Enthusiastic	Irritated
Energetic	Stressed
Happy	Annoyed
Hatred	Alert
Angry	Pleasure
Tense	Provoked
Satisfied	Sad
Uneasy	Depressed
Attacking	Apprehensive
Motivated	Disappointed
Concerned	Comfortable
Pressured	

2.3.1 Method**2.3.1.1 Participants**

Eleven sport psychology professionals with experience of both research and applied practice were recruited by email using opportunity sampling. The eleven recruited sport psychology professionals had an average of 12.4 years of experience ($SD = 8.7$) working across 19 different sports. Ethical approval was granted for this study, as well as the three succeeding studies (SFEC 2018-127 see Appendix C).

2.3.1.2 Procedure

A survey assessed the extent to which the sport psychology professionals believed that the 39 presented emotion adjectives (procured from the SEQ longlist item pool – see

Table 2.1) were relevant to specifically athletes' in-competition emotional experiences. For each of the 39 listed items, the experts on the panel were asked to rate their agreement with the statement 'the relevance of this emotion will be easily understood by an athlete attempting to identify and record their own emotions in a within-game sporting context'. Participants' agreement with this statement was measured on a 5-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*).

2.3.1.3 Statistical Analysis

Decisions regarding the relevance or exclusion of items were based upon a combination of a sum score and a content validity ratio (CVR) method. The sum score method is a well-supported and well-used method (Hardesty & Bearden, 2004), which can assess the utility of individual questionnaire items when developing a measure. There is also support within the literature for employing a CVR technique (Wilson et al., 2012). The CVR score was calculated using Lawshe's (1975) technique and any item which presented a CVR score of less than 0 was shortlisted for exclusion.

2.3.2 Results

The panel of sport psychology professionals gave a rating of perceived relevance for each of the 39 items. In this instance, the average sum score was calculated ($M = 42.15$) and any item which elicited a score of more than one standard deviation ($SD = 6.37$) below that average was shortlisted for exclusion. This method led to seven items, with a sum score of 35 or below, being considered for exclusion. There were 11 items with a CVR score of less than zero which were also shortlisted for exclusion. Each of the seven items that failed to meet the sum score threshold were also found to have CVR scores of less than zero and were excluded. Of the four remaining items with a CVR score below zero, two presented a sum score of only .22 above the threshold of 35.78 and were also excluded. The other two items presented scores that were further above the sum score threshold and were consequently

included within the next phase of the scale development. Multiple expert analysis techniques can be used in tandem in order to maximise efficacy (Morgado et al., 2018), and in this instance, uniformity between the two scoring techniques was paramount in the decision to exclude items. In addition, the sum score method has been shown to be most effective in contributing towards the development of questionnaire item lists (Hardesty & Bearden, 2004). Overall, 9 items were excluded, leaving 30 items to be employed in the subsequent studies investigating in-competition emotional states. All items shortlisted for exclusion can be found in Table 2.2.

Table 2.2

Items Shortlisted for Exclusion Following the Expert Phase of Research

Item	Sum Score	Content Validity Ratio
<i>Fulfilled</i>	31	-0.455
<i>Dejected</i>	31	-0.455
<i>Daring</i>	31	-0.455
<i>Hatred</i>	34	-0.273
<i>Uneasy</i>	35	-0.273
<i>Depressed</i>	35	-0.273
<i>Joyful</i>	35	-0.091
<i>Exhilarated</i>	36	-0.273
<i>Content</i>	36	-0.273
Cheerful	38	-0.091
Pleasure	40	-0.091

Note. Excluded items in italics.

2.3.3 Discussion

This study used the analysis of a panel of sport psychology professionals to develop a shortlist of 30 items which were considered relevant for athletes' in-competition emotional experiences. Although this constitutes evidence of an initial validity assessment, further research was required to develop the in-competition scale and assess its validity. The inclusion of athletes in each of the successive studies provided a foundation for creating an in-competition emotional scale that was valid within the contexts it was designed to assess.

2.4 Study 2: Confirmatory Factor Analysis and Item Reduction

The aim of this study was to develop a short-form questionnaire that was relevant for recording athletes' in-competition emotional experiences. To address this, data were collected from athletes regarding their common emotional experiences during sporting competition.

2.4.1 Method

2.4.1.1 Participants

Participants in this study were university athletes ($N = 402$) recruited from two UK universities. The data set included 270 males and 129 females, and the average age of the participants was 20.2 years ($SD = 2.2$). On average, the participants had 9.5 years' experience competing in their sport ($SD = 4.5$). The sampled sports included individual sports ($n = 80$), such as swimming ($n = 9$) and tennis ($n = 10$), as well as team sports ($n = 320$) such as football ($n = 163$) and netball ($n = 33$). Two participants did not specify their sport.

2.4.1.2 Procedure

The participants volunteered to take part in this survey study following a university lecture. At the start of the survey, the participants were asked to state their 'chosen sport' and the number of years' experience that they had competing in that sport. The item list of thirty emotions developed in Study 1 was presented to the participants and they rated how frequently they experienced the given emotions during sporting competition. The participants rated the items on Likert scales ranging from 0 (*Not at all*) to 4 (*Extremely*). This represents the same anchoring system used in the development of the SEQ (Jones et al., 2005).

2.4.1.3 Statistical Analysis

Each of the 30 items that were presented to the athletes had been previously categorised into one of the five latent factors in the original SEQ development process (Jones et al., 2005). Of the 30 items, 7 items were categorised into an anger factor and 7 into an anxiety factor; both the excitement and the happiness factors contained 6 items, and 4 items

were linked to the dejection factor. The SEQ five-factor structure was rigorously supported both theoretically and statistically and was consequently used as the scale structure in a Confirmatory Factor Analysis (CFA) to develop the new, brief in-competition questionnaire.

First, the data was screened for any missing data using SPSS (Version 25). Fourteen data points were found to be missing. These missing data presented a non-significant Little's MCAR test result ($p = .06$) indicating that the data points were missing at random. The missing data was replaced using the Expectation Maximisation (EM) method which allows the relationships between the data and variables to be preserved (Brown, 2006). Any impact of the EM method upon the standard error of individuals can be ignored as these standard errors are not vital in factor analysis (Brown, 2006).

Two measures of sampling adequacy were completed to assess the dataset. The Kaiser Meyer-Olkin value was .879 which is above the recommended value of .6, similarly, Bartlett's test of sphericity was significant, $\chi^2(435) = 5278.39, p < .001$ (Tabachnick & Fidell, 2007). Univariate normality was tested by calculating skewness and kurtosis scores for each item (Groenveeld & Meeden, 1984). Only the item 'sad' showed univariate kurtosis and no item showed univariate skewness. The multivariate normality was checked using Mardia's normalised coefficient of multivariate normality (Mardia, 1970) and it was found that the data did not show a multivariate normal distribution.

As a result of the normality tests, the utilised CFA estimation method needed to account for the non-normal multivariate distribution. The maximum likelihood method can often account for minor departures in normality (Chou & Bentler, 1995), yet the robust maximum likelihood method (Satorra & Bentler, 1994) is stronger in its estimation across differing levels of normality and sample size (Curran et al., 1996). Additionally, the robust maximum likelihood method is commonly used for similar data distribution constraints to

those that this data presented (e.g., Lane et al., 1999), and was therefore utilised in this analysis. The Lavaan package (Rosseel, 2012) in R was used for all CFA procedures.

Two Items per Factor Management. The aim of this study was to produce the most parsimonious sporting emotion scale for use in an in-competition context. The error variance and participant comprehension issues associated with single item measures precluded a one item per factor questionnaire (Harmon-Jones et al., 2016). Similarly, when time constraints are of paramount concern, a large number of items per factor would be counterproductive practically and may cause issues with participant attitudes towards completion (Horvath & Rothlin, 2018). Therefore, a two item per factor design offered the most parsimonious and effective means to assess emotion here (Burisch, 1997). As a result of the criteria for over-identification, experts can discourage researchers from developing scales with two items per factor unless previous evidence or theory provide a strong enough reason (Brown, 2006). In this instance, a short, statistically sound emotion scale would provide new avenues for research and more accurate emotion measurements and intervention assessments. This represented a comprehensive enough justification to proceed with a two item per factor scale, compared to a scale with a larger number of items per factor.

For a two item per factor model to be statistically sound, it must meet stringent criteria that allow for the model to be over-identified (Brown & Moore, 2012). The over-identification of a model is achieved when the number of known values exceeds the number of freely estimated model parameters, which allows the falsifiability of the model to be tested and fit statistics to be calculated (Kenny & Milan, 2011). Brown (2006) recommended a number of practices to implement for a two item per factor model to be found to be over-identified. The model must include more than two factors, both items loading onto each factor must be equally constrained, each latent variable must be correlated with at least one other latent variable, and the errors between indicators must be uncorrelated (Brown, 2006).

Model Fit Statistics. Several model fit indices were used to assess the overall fit of the model. These indices included the Satorra-Bentler χ^2 statistic, Robust Comparative Fit Index (RCFI), Robust Tucker Lewis Index (RTLTI), Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR) (Kline, 2005). In the present analysis, the non-centrality-based indices' thresholds used to indicate good fit were RCFI > .95 and RMSEA values close to or below .06 (Hu & Bentler, 1999), with RCFI > .90 and RMSEA values below .08 indicating acceptable fit (Bentler, 1990). The RTLTI is a relative fit index and shares the same good and adequate fit thresholds as the RCFI (Hu & Bentler, 1999). The absolute fit indices include the χ^2 statistic and the SRMR value. SRMR values should fall close to or below .08 (Hu & Bentler, 1999), with values that fall below .05 indicating very good fit (Steiger, 1989). The χ^2/df statistic value indicates an adequate fit if it is smaller than 5, and a good fit if the value is below 1 (Marsh & Hocevar, 1985). The χ^2 statistic should always be accompanied by a non-significant *p* value.

2.4.4 Results and Discussion

First, a CFA model which included all 30 items was assessed (RCFI = .85, RTLTI = .83, RMSEA = .06, SRMR = .08). Several subsequent methods were then adopted to develop the most parsimonious and valid instrument, as the brevity and practicality of the scale would be improved through item reduction. The factor loadings presented in the full 30 item CFA were analysed (see Table 2.3). Any item which presented a loading of below .6, whilst retaining the theoretical coherence of the factor, was removed from the analysis (Matsunaga, 2010). This led to the removal of six items across four of the factors.

The remaining 24 items were then reduced using a reliability removal analysis method (Raubenheimer, 2004). This analysis used the command 'omega if item is removed' as the primary approach to item removal. The method was completed for each of the five factors in a step-by-step process with an item being removed after each level of analysis (see Table

2.4). Although omega was used as the reliability measure in this instance, using Cronbach's Alpha as an alternative reliability assessor in the same item removal process was found to yield the same factor pairings.

Disappointed and unhappy (dejection), enthusiastic and energetic (excited) and happy and cheerful (happiness), were all shown to be the most reliable pairings for their respective factor. These items also presented the two highest factor loadings for their factors following the full item list CFA model. As a result of this concordance, these three item pairs were chosen as the items to represent their respective factors, but the items for the remaining two factors, Anxiety and Anger, required further finalisation.

Table 2.3*The Factor Loading Scores for all 30 items Included in the Initial 30 item Confirmatory**Factor Analysis*

Factor	Item	Factor Loading
Anger	Frustrated	.784
	Irritated	.753
	Angry	.758
	Annoyed	.750
	Furious	.678
	Provoked	.628
	<i>Attacking</i>	.336
Happiness	Happy	.774
	Cheerful	.694
	Pleased	.661
	Satisfied	.646
	Pleasure	.618
	<i>Comfortable</i>	.590
Anxiety	Anxious	.745
	Nervous	.728
	Stressed	.728
	Pressured	.686
	Tense	.671
	<i>Concerned</i>	.501
Excitement	<i>Apprehensive</i>	.499
	Enthusiastic	.752
	Energetic	.747
	Excited	.611
	Motivated	.610
	<i>Alert</i>	.434
Dejection	<i>Charged</i>	.371
	Unhappy	.796
	Disappointed	.715
	Upset	.693
	Sad	.649

Note. Excluded items in italics.

Table 2.4*The Reliability Removal Process for each of the Five Composite Factors of the Brief In-**Competition Emotion Scale*

Factor	Item	ω if item deleted	ω if item deleted	ω if item deleted	ω if item deleted	Spearman-Brown if item deleted
Anger	Frustrated	.843	.820	.798	.730	.730
	Irritated	.849	.829	.814	.761	.762
	Annoyed	.852	.830	.804	.766	.767
	Angry	.842	.823	.821		
	Furious	.853	.850			
	Provoked	.859				
Happiness	Happy	.770	.714	.590		.590
	Cheerful	.781	.723	.630		.630
	Pleased	.787	.751	.749		.749
	Satisfied	.777	.752			
	Pleasure	.784				
Anxiety	Anxious	.789	.747	.677		.677
	Nervous	.794	.751	.688		.688
	Stressed	.810	.797	.833		.833
	Pressured	.822	.816			
	Tense	.822				
Excitement	Enthusiastic	.672	.578			.578
	Energetic	.679	.631			.631
	Excited	.749	.749			.749
	Motivated	.751				
Dejection	Unhappy	.722	.650			.652
	Disappointed	.758	.694			.696
	Upset	.766	.760			.760
	Sad	.784				

2.4.4.1 Factor Finalisation

The anger and anxiety factors required further investigation to ascertain the optimal items for each factor. The anxiety construct included ‘stressed’ and ‘nervous’ which both loaded onto the anxiety factor alongside ‘anxious’ at the same strength (.728) in the full item CFA analysis. Nevertheless, ‘stressed’ was excluded in favour of ‘nervous’, first, because ‘stressed’ presented a lower sum score in Study 1 and the results from Study 2 indicated that the athletes experienced ‘stressed’ less frequently. Second, there were poorer model fit

statistics and factor loadings when ‘stressed’ was included in a two-item model with ‘anxious’ compared to when ‘nervous’ was included with ‘anxious’.

Within the full item CFA analysis, ‘angry’ had a primary factor loading of .758 which was a slightly higher loading onto the anger factor than ‘irritated’ (.753). Yet, the reliability analysis showed that ‘angry’ had a lower contribution to the anger factor reliability than ‘irritated’. Therefore, further comparisons were sought to ascertain which item should be excluded from the model. This investigation included running two CFA models, one with ‘angry’ and ‘frustrated’ inputted as the two anger items and one with ‘irritated’ and ‘frustrated’. The overall model fit statistics for both met all of the thresholds, however, the factor loadings were lower in the model with ‘angry’ (.705) and ‘frustrated’ (.764) than the model which included ‘irritated’ (.774) and ‘frustrated’ (.805).

2.4.4.2 Ten Item Model

After the final exclusions, the ten psychometrically strongest items included in the final model were: cheerful, happy, disappointed, unhappy, anxious, nervous, energetic, enthusiastic, irritated and frustrated (see Appendix A). A CFA model, which met the two item per factor criteria (Brown, 2006), was then run with all ten items loaded onto their respective factors. The results showed a well-fitting model which surpassed each of the required model fit statistic thresholds, S-B $\chi^2(30) = 38.360, p = .141$, RCFI = .993, RTLI = .990, RMSEA = .028, SRMR = .031. Scale reliability was calculated using the Spearman-Brown split half correlation which has been shown to be the most accurate reliability measure for a two-item factor (Eisinga et al., 2013). Each of the factors showed adequate reliability statistics above .7 (Parsons et al., 2019). The factor reliability values can be found in Table 2.6.

2.5 Study 3: Examining the Concurrent Validity

The aim of the third study was to examine the concurrent validity of the newly developed ten item scale, henceforth named the Brief In-Competition Emotion (BICE) scale. Concurrent validity is assessed by correlating the scores of similar factors across multiple questionnaires (Kimberlin & Winterstein, 2008) and is an important procedure in scale development processes (e.g., Nassi et al., 2017). In this instance, the BRUMS was used, as the similarities between the BRUMS and the BICE scale latent factors were evident. Although the BRUMS was developed based upon the POMS scale, it has been assessed with adult athletes (Terry et al., 2003), and has been shown to be a valid measure of affect (see its inclusion in the concurrent validity assessment of the SEQ). In the context of this study, it was hypothesised that positive correlations would be found between the BRUMS factors of tension, depression, anger and vigour with the BICE factors of anxiety, dejection, anger and excitement factors respectively.

As previously described, a limitation of the BRUMS instrument is that vigour is the only positive factor. Consequently, the BICE scale was also compared with the PANAS. This comparison allowed the happiness BICE scale factor to be assessed for validity. It was hypothesised that the BICE scale factors of happiness and excitement would be positively correlated with the positive PANAS factor, and the factors of anger, anxiety and dejection would be positively correlated with the negative PANAS scores. Both the PANAS and the BRUMS were also included in the SEQ concurrent validity correlation assessment, as the scales consist of composite factors which can be easily compared to the five emotion factors that the SEQ and the BICE share.

2.5.1 Method

2.5.1.1 Participants

The participant cohort consisted of athletes from three different UK universities ($N = 109$). The 109 participants ($n = 42$ female) had a mean age of 19.74 years ($SD = 1.59$).

2.5.1.2 Procedure

A concurrent validity assessment involving three questionnaires was not possible to complete in an in-competition context owing to the time constraints that are placed on in-competition data collection. The impractical nature of in-competition data collection is an issue that it is hoped the BICE scale may aid in combatting. As a result of these time constraints, Study 3 comprised a survey in which the participants were asked to recall the most recent sporting competition in which they had participated and, with this competition in mind, complete the BICE, the PANAS and the BRUMS. The participants were asked to complete the scales whilst recalling the intensity of the emotions they had felt *in-competition*. The BICE scale and the BRUMS assessed affect on a scale of 0 (*Not at all*) to 4 (*Extremely*) and the PANAS used a scale of 1 (*Not at all*) to 5 (*Extremely*).

2.5.1.3 Statistical Analysis

The data was examined for normality using the Kolmogorov-Smirnov normality test (Ghasemi & Zahedrasl, 2012) and was found to be largely non-normally distributed and therefore required non-parametric testing. Skewness and Kurtosis were also assessed, with only the BRUMS depression factor showing a result indicating kurtosis (2.47). Owing to these results, a non-parametric Spearman correlation was completed rather than a Pearson's. Any Spearman correlation above .8 should be considered a high correlation and a correlation between .4 and .8 should be considered moderate to moderately high (Zhu, 2012).

2.5.2 Results

To optimise the accuracy of the participants' recall, any participant who had competed in their chosen sporting competition more than four weeks before the completion of the survey was excluded from the participant group. This exclusion criteria removed 55 participants from an initial cohort of 164. The remaining participants had experience of competing in sports including football ($n = 32$), badminton ($n = 15$) and hockey ($n = 13$). The

mean years' experience competing was 8.0 years ($SD = 4.8$), and on average the recalled contest took place 1.75 weeks prior to completion of the survey ($SD = 1.06$).

Of the 109 participants, three participants only completed the BICE scale and were therefore included in the reliability analysis but excluded from the concurrent validity tests.

2.5.2.1 Reliability Analysis

First, the BICE scale factors were each assessed for reliability using a Spearman Brown split-half correlation (Eisinga et al., 2013). Each of the factors presented a reliability of above .7 (see Table 2.6).

2.5.2.2 Validity Assessment

The correlation coefficients for the concurrent validity assessments can be found in Table 2.5. As hypothesised, the results showed moderate to high correlations between the comparable factors from the BRUMS and the BICE scales (see Zhu, 2012). The two anger factors were moderately highly correlated ($r_s = .664$), as well as the depression and dejection factors ($r_s = .675$) and the excitement and vigour factors ($r_s = .661$). The tension and anxiety factors were highly correlated ($r_s = .820$). Collectively, these correlation analysis results support Hypothesis one. The positive PANAS subscale was found to be moderately highly correlated with both the excitement BICE factor ($r_s = .739$) and the happiness BICE factor ($r_s = .655$). Similarly, the negative PANAS scores were moderately and moderately highly correlated to the BICE factors of anxiety ($r_s = .645$), anger ($r_s = .446$) and dejection ($r_s = .478$), thus supporting Hypothesis two.

Table 2.5*Bivariate Spearman's Rho Correlations between BICE scale Factors, BRUMS Factors and PANAS Scores (Study 3)*

	2	3	4	5	PANAS Positive	PANAS Negative	BRUMS Anger	BRUMS Confusion	BRUMS Depression	BRUMS Fatigue	BRUMS Tension	BRUMS Vigour
1. Anxiety	.114	.078	.072	.114	.132	.645**	.136	.328**	.209*	.274**	.820**	-.028
2. Anger		-.160	-.28**	.727**	-.223*	.446**	.664**	.412**	.615**	.305**	.239*	-.187
3. Excitement			.702**	-.339**	.739**	-.044	-.228*	-.061	-.194*	.036	.039	.661**
4. Happiness				-.450**	.655**	-.177	-.336**	-.089	-.318**	.081	-.033	.489**
5. Dejected					-.388**	.478**	.615**	.458**	.675**	.321**	.321**	-.268**

Note. $N = 106$ * $p < .05$, ** $p < .01$

2.5.3 Discussion

The BICE scale was shown to indicate a unique addition to the literature as the measure possesses practical benefits, such as a concise structure, whilst still assessing emotions in a similar capacity to the PANAS and the BRUMS, both of which are well-established measures of affect (Jones et al., 2005).

Although instructed to recall the emotions they had experienced whilst competing, since the participants did not actually complete the questionnaire in-competition, it could be argued that the emotions reported may not provide a complete reflection. Nevertheless, the exclusion of four items from the SEQ 22 item list during Study 1, indicated that the experts were able to differentiate the emotions that athletes experience before competition from those that they experience during competition. In addition, the data from Study 2 showed that the athletes tended to experience the BICE scale emotions more frequently during competition than other items included in the pre-competition specific SEQ. This evidence supports the notion that the athletes sampled during Study 3 were likely to have accurately differentiated the emotions that they had experienced during the competition from those that they had experienced before and after. Nonetheless, a further validation assessment which involved the measurement of athletes' emotions, taken at an in-competition time-point, was conducted.

2.6 Study 4: Predictive Validity

The aim of this study was to assess the predictive validity of the Brief In-Competition Emotion (BICE) scale when administered during sporting competition. Predictive validity measures the extent to which a scale can predict scores on a criterion measure. In this instance, the criterion measures were the emotional control subscale from the Test of Performance Strategies (TOPS; Thomas et al., 1999) and a subjective and objective performance assessment. In assessing the predictive validity of the SEQ using correlation analysis, Jones et al. (2005) included the TOPS emotional control subscale. Jones et al.

(2005) found that pre-competitive feelings of dejection and anger were negatively correlated with the TOPS emotional control subscale and excitement and happiness were positively correlated with the TOPS scale. It was thus decided that the TOPS emotional control scale should be included in the predictive validity assessment of the BICE, so as to examine the effect of an individual's tendency to control their emotions on the emotions that they experience in-competition. Nonetheless, despite sharing the same five composite emotion factors, the BICE scale assesses specifically in-competition emotion rather than pre-competitive emotion, therefore the analysis in this study was exploratory in nature.

2.6.1 Method

2.6.1.1 Participants

The participants were recruited at competitive amateur table tennis tournaments in the United Kingdom. There were 74 participants recruited with a mean age of 31.6 years (SD = 13.3). Each of the participants completed the BICE scale during a doubles table tennis match.

2.6.1.2 Measures

Emotion. The athletes' emotional states were measured using the Brief In-Competition Emotion Scale. This questionnaire assessed emotion across the five principal factors of anxiety, happiness, dejection, excitement and anger, each measured by two items. The questionnaire used a 5-point Likert scale ranging from 0 (*Not at All*) to 4 (*Extremely*) for each item (see Appendix A for the full BICE scale).

Subjective Performance. The participants were asked to rate how well they believed they were playing using a 70mm visual analogue scale ranging from *Poor* to *Excellent*.

Objective Performance. The athletes' objective performance was recorded as the points' difference at the time of the emotion measurement. This was the number of points the participant pair had scored subtracted by the number of points their opponents had scored.

Emotional Control. Emotional control was measured using the emotional control subscale from the TOPS (Thomas et al., 1999). This self-report subscale featured four items which assessed the athletes' ability to control their emotions during matches (for example, "My emotions keep me from performing at my best"). The emotional control subscale was measured on a 5-point Likert scale ranging from 0 (*Never*) to 4 (*Always*). A higher score represented a lower perception of personal emotional control.

2.6.1.3 Procedure

The participants completed the BICE scale during the official one-minute break in play allocated between the second and third game of their doubles match. At this time, the participants also recorded a visual analogue scale assessment of their own performance during the match. The match score line following the second game was also noted. Following the match, the participants completed the emotional control subscale from the TOPS questionnaire (Thomas et al., 1999).

2.6.1.4 Statistical Analysis

Scale reliability was assessed using Spearman-Brown split half scores. The correlations involving the personal subjective performance measure were completed using a Pearson's correlation, whilst each of the other correlation analyses were completed using a Spearman's Rho test as the variables were non-normally distributed. Only correlations involving two variables which are both non-normally distributed require the use of non-parametric correlation analysis (Armstrong, 2018). A mixed factorial ANOVA involving Emotion Factor and Competition Situation was completed to ascertain the participants' emotional experiences dependent upon how successful they were in the match. Emotion Factor was a repeated measures variable in that all participants recorded a score for each of the five BICE scale factors. Competition Situation was an independent groups variable as all participants were either winning, drawing or losing when the measurements were taken.

2.6.2 Results

2.6.2.1 Scale Reliability

All of the five BICE scale factors were shown to have a reliability score of above .7, which is the required threshold for a reliable scale (Parsons et al., 2019) (see Table 2.6).

Table 2.6

Spearman-Brown Split Half Correlation, Mean and Standard Deviation for each of the Five Factors of the Brief In-Competition Emotion Scale in Study 2, Study 3 and Study 4

Factor	Study 2			Study 3			Study 4		
	Spearman-Brown Split Half Correlation	Mean	Standard Deviation	Spearman-Brown Split Half Correlation	Mean	Standard Deviation	Spearman-Brown Split Half Correlation	Mean	Standard Deviation
Anger	.770	2.75	1.94	.754	2.96	2.05	.870	2.24	2.30
Excitement	.749	6.17	1.45	.708	6.06	1.39	.747	5.46	1.84
Anxiety	.833	3.96	2.08	.873	3.30	2.21	.742	1.90	1.83
Happiness	.749	5.46	1.68	.756	5.55	1.57	.814	4.57	2.26
Dejected	.760	2.17	1.82	.740	1.86	1.93	.716	2.03	2.12

Note. Study 2 $N = 402$, Study 3 $N = 109$, Study 4 $N = 74$

2.6.2.2 Correlations

Table 2.7 shows the correlations between the five BICE factors, the subjective and objective performance measures and the TOPS emotional control subscale. The subjective and objective performance measures were moderately correlated ($r = .548$). Only Excitement presented no correlation with the personal subjective performance measure. Happiness was positively correlated with subjective performance ($r = .379$), such that participants who believed they had performed better in the match so far were happier. Conversely, Anxiety, Dejection and Anger were all negatively correlated with subjective performance ($r = -.301$, $r = -.526$ and $r = -.519$ respectively). Happiness presented a low positive correlation, and Dejection and Anger a low and moderate negative correlation, with the objective performance measure. The Anxiety and Excitement factors both presented no correlation with objective performance.

The BICE Anxiety factor showed a low correlation with the TOPS emotional control subscale scores ($r_s = .256$). Whereas Excitement, Happiness, Dejection and Anger were not correlated with the TOPS emotional control subscale.

Table 2.7

Bivariate Correlations between BICE Scale Factors, Subjective and Objective Performance Measures, and the TOPS Emotional Control Subscale

	Pearson's Correlation	Spearman's Rho Correlation	
BICE scale Factor	Subjective Performance	Objective Performance	TOPS Emotional Control Subscale
Happiness	.379**	.316**	-.030
Excitement	-.142	-.107	.196
Anxiety	-.301*	-.181	.266*
Dejection	-.526**	-.511**	.197
Anger	-.519**	-.366**	.195

Note. $N = 74$

* $p < .05$, ** $p < .01$

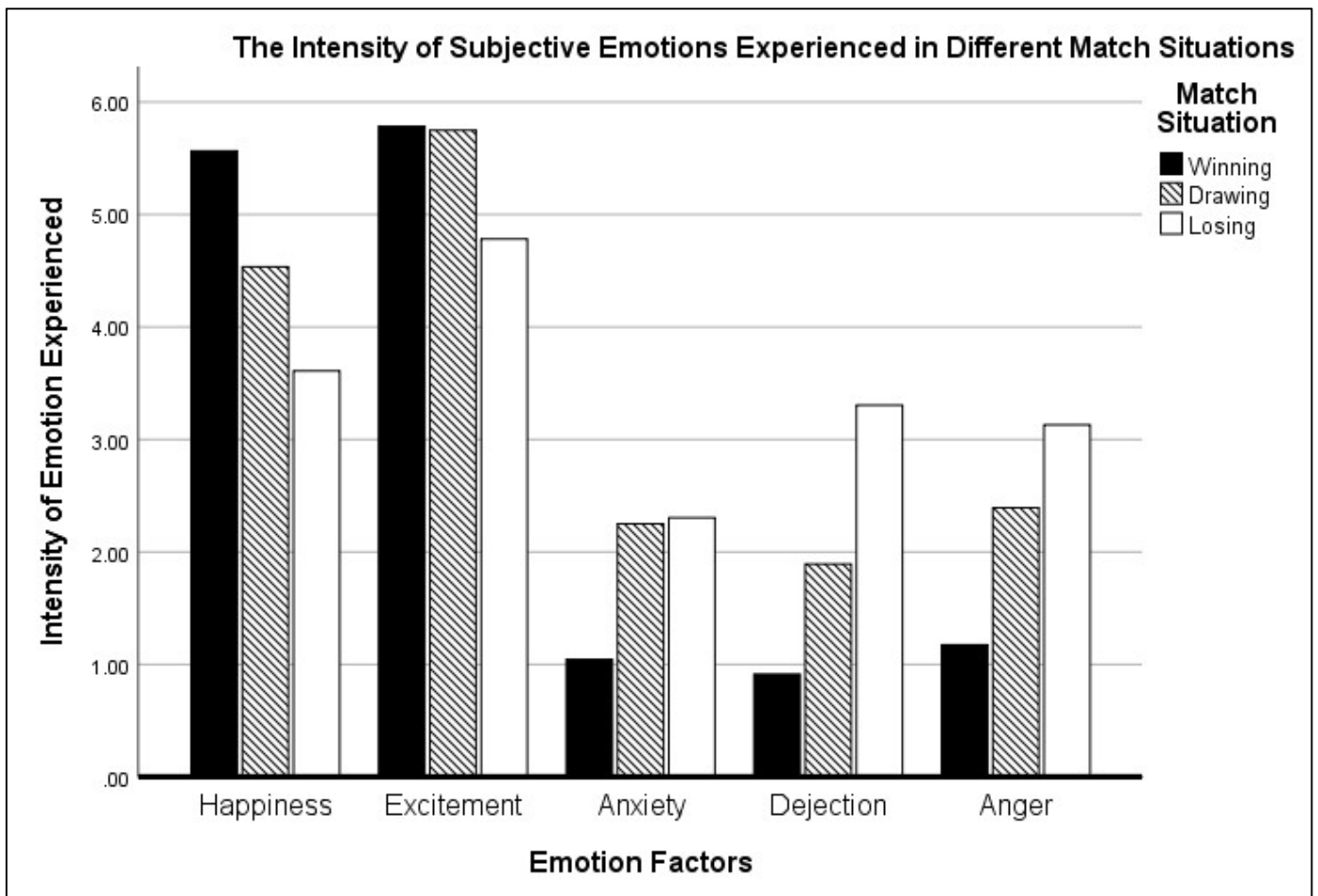
2.6.2.3 ANOVA

A mixed factorial ANOVA was employed to determine the effect of competition situation on the athletes' emotional states. There was a significant main effect of Emotion Factor, $F(2.24, 810.26) = 54.26, p < .001, \eta_p^2 = .43$, such that the five emotions measured by the BICE scale were experienced at different intensities from one another (see Table 2.5). The main effect of Competition Situation was also significant, $F(2, 52.74) = 5.79, p = .005, \eta_p^2 = .14$. There was a significant interaction effect involving Competition Situation and Emotion Factor, $F(4.47, 140.58) = 4.71, p = .001, \eta_p^2 = .12$. Bonferroni pairwise comparisons showed that there was a significant difference between the Happiness scores for those participants winning ($M = 5.57, 95\% \text{ CI } [4.67, 6.46]$) and losing ($M = 3.61, 95\% \text{ CI } [2.72, 4.50]$). Additionally, participants felt less dejected when winning ($M = 0.91, 95\% \text{ CI } [.12, 1.71]$) compared to when losing ($M = 3.30, 95\% \text{ CI } [2.51, 4.10]$) and less dejected when

drawing ($M = 1.89$, 95% CI [1.17, 2.62]) compared to when losing. Furthermore, the participants were significantly less angry when winning ($M = 1.17$, 95% CI [.26, 2.09]) compared to when losing ($M = 3.13$, 95% CI [2.22, 4.04]). There were no significant differences in Excitement or Anxiety scores across Competition Situation. The comparison of the intensity of emotions experienced across Competition Situation can be seen in Figure 2.1.

Figure 2.1

The Intensity of BICE Scale Factor Emotions Experienced Whether Winning, Drawing or Losing.



Note. $N = 74$

2.6.3 Discussion

These results lend support to the predictive validity of the BICE scale. The significant correlations between the performance measures (both subjective and objective) and the BICE factors, indicate that, in general, individuals who are performing better and who rate

themselves as performing better, feel happier. Similarly, those who are performing worse and rate themselves as performing worse, experience more negative emotions (dejection, anger and anxiety). The results presented within this study offer support to previous post-match emotional recall research which has provided evidence for a relationship in basketball matches between in-competition happiness and anger with successful and unsuccessful objective performance respectively (Uphill et al., 2013). In addition, the BICE Anxiety factor was found not to be related to the objective performance measure, as was also shown in the Uphill et al. (2013) study. This finding indicates that the anxiety that athletes experience when competing may be more closely related to subjective perceptions of their own performance rather than objective score lines. The lack of correlation between the Excitement factor with subjective and objective performance suggests that the athletes' enthusiasm and energetic nature was unchanged whether subjectively or objectively performing well.

The results of the correlations between the BICE scale factors and the TOPS emotional control scale directly contrast with those of the pre-competitive SEQ with the TOPS. It is suggested that this may be as a result of the BICE scale and the TOPS scale differing in their assessment technique. The TOPS emotional control subscale assesses how much control athletes generally perceive themselves to have over their emotions, yet the BICE scale measures athletes' subjective emotions at a specific time point in a competition. For instance, when completing the emotional control subscale, participants are asked, as an example, 'How often does your performance suffer when something upsets you during competition?'. However, it is possible that, for at least those participants who were winning when they completed the BICE scale, few events had so far occurred within the match to upset the athletes. As a result, the TOPS emotional control subscale may not offer the most valid assessment of the BICE scale's predictive validity. Both the subjective and objective performance measures seem to represent better investigations of the BICE scale predictive

validity as they measure concepts that are specific to the same context in which the athletes' emotional states are assessed.

Nevertheless, the Anxiety BICE scale factor was found to be correlated with the TOPS emotional control subscale. These data can be interpreted to indicate that athletes who rated themselves as subjectively more anxious whilst they were competing also recognised that they generally struggle to control their emotions during competition.

2.7 General Discussion

The aim of this series of studies was to develop and assess the validity of a short, self-report in-competition emotion measure that could be used in both research and applied settings. This aim was achieved following four studies which focused upon, first, the development of the BICE scale using the expertise of sport psychology professionals and 402 athletes, and second, the validation assessment of the new scale with two further athlete cohorts. The ten items included in the BICE scale were found to load onto one of five theoretically supported latent factors: anger, anxiety, dejection, happiness and excitement (two items per factor). Following the scale development studies, a concurrent validity investigation was carried out which showed that the five BICE scale factors measured emotion in a similar manner to the analogous factors within both the PANAS and the BRUMS. The validation assessment of the BICE scale was then further supported through the inclusion of a fourth study which presented evidence to support the feasibility for the use of the BICE scale in an in-competition context (doubles table tennis matches) and additionally showed that the scale presented suitable reliability. The predictive validity was also assessed in this study, and BICE factors were found to be moderately to highly correlated with both subjective and objective performance measures.

The BICE scale is unique when compared to the pre-competition specific SEQ (Jones et al., 2005), as the BICE scale development process sought to produce a psychometrically

strong scale which was relevant to an exclusively in-competition context. In doing this, 13 out of the final 22 SEQ items which were not pertinent to athletes' in-competition emotional states were excluded from the BICE scale, and an item (frustrated) not found in the final SEQ was included. The BICE scale development process has explicitly shown that the 10 BICE items are each relevant in measuring an athlete's in-competition emotional state, regardless of whether they are also relevant in measuring an athlete's pre-competitive emotional state. The BICE scale development methodology differed from the SEQ development process in chronological specificity as participants were instructed to only consider in-competition emotions. This in-competition specificity allows researchers using the BICE scale to confidently undertake an assessment of exclusively in-competition emotion without any peripheral interference from extraneous items. The BICE scale is also distinct from other existing measures (i.e., BRUMS, POMS and PANAS), as demonstrated by the lack of similarity between the BICE scale item list and the item lists included in these measures.

As other emotion measurement authors often caution, questionnaires do not always represent best practice for measuring individuals' emotional experiences (Lane et al., 2012). Typically, a questionnaire cannot record a wide range of subjective emotions to the same extent as a qualitative exploration (e.g., Martinent & Ferrand, 2015). Nevertheless, questionnaires offer researchers and practitioners a normative measure that can be used to easily compare assessments. In addition, despite its comparable parsimony, in Study 3 the BICE scale recorded similar latent factor scores as the PANAS and the BRUMS, both of which are composed of many more items.

The concise nature of the BICE scale offers a potential solution to the time-constrained methodological issues experienced by researchers and practitioners. Within a sporting context, the BICE scale affords researchers and practitioners more opportunities for self-report emotion measurements to take place, as the measure is short enough to be

completed during almost any break in play (see Burke, 2007 for a summary of interval characteristics across various sports). This utility was evidenced during Study 4, in which the athletes completed the questionnaire during the allotted one-minute break in play between game two and three of their table tennis matches. By using the BICE scale for this kind of data collection, researchers will be able to investigate research questions that have been otherwise impractical in the past, and practitioners will be able to accurately understand the effectiveness of a range of emotional regulation techniques and interventions. An additional advantage of the BICE scale is the ease with which longitudinal emotional assessments can be conducted by both researchers and practitioners. As well as the practical benefits of completing the short BICE scale at multiple time points during competition, athletes may also be more inclined to complete a specifically short questionnaire on multiple occasions compared to a longer measure (Horvath & Rothlin, 2018). Emotions have been shown to fluctuate during sport (e.g., Hetland et al., 2018), and without having a tool capable of measuring these emotions, the effect of these transitory states upon the athlete would stay hidden. The development of the BICE scale addresses this often-cited issue within the sport emotion literature (see Campo et al., 2018; Campo et al., 2019; Hetland et al., 2018; Uphill et al., 2012), and offers an alternative method for researchers. Finally, although the BICE scale represents a potentially useful tool in the measurement of emotions during a range of sporting competitions, a limitation of the scale is that it is less suitable for use in sports without a recognised break in competition (for example, marathon or cycling races). In these contexts, an in-competition emotion questionnaire may not be the most efficacious methodology and instead, it is recommended that innovative, non-intrusive, real-time emotion measurement techniques should be developed and utilised (see Hetland et al., 2019).

In conclusion, a parsimonious but robust and psychometrically strong emotion scale has been developed which is able to assess athletic emotional experience across the five

principal factors of anger, anxiety, happiness, excitement and dejection. This is the first questionnaire to be developed specifically to assess in-competition sporting emotions and the BICE scale has been shown to offer a valid and reliable, brief assessment of emotion in the contexts assessed. This newly developed technique can assist in furthering academic research opportunities and improving the applied assessment of emotion. Scale validation is a continual process and, in order to examine new environments within which the BICE scale may present benefits, further validation and feasibility tests are encouraged.

Chapter 3: Collective Emotions in Doubles Table Tennis

This chapter draws from the following manuscript:

Freemantle, A.W.J., Stafford, L., Wagstaff, C.R.D., & Akehurst, L. (2021). Collective emotions in doubles table tennis. [Manuscript Invited for Revision], *Journal of Sport and Exercise Psychology*.

3.1 Abstract

Researchers have shown that the emotions that athletes experience during sporting competition can be transferred between team members to create collective team emotional states. Nevertheless, collective emotions have not yet been investigated for sporting dyads. In this study the emotional experiences of 68 doubles table tennis players (34 dyads) were examined at three time points, pre-competition, in-competition and post-competition. It was found that the intensity of each emotional state differed as a function of match situation (positive/negative). Moreover, in-competition anxiety, dejection and anger were shown to predict poorer subjective performance, and anxiety was shown to negatively impact future objective athlete performance. Most pertinently, within-dyad emotional aggregation was identified for athlete in-competition happiness and dejection, and for post-competition happiness, dejection and anger. These findings represent the first quantitative evidence of emotional convergence in sport dyads and provide support for the social-functional theory of emotion in sport.

3.2 Introduction

Athletes experience a range of emotion during sporting competition and these emotions can vary in response to the context specific events which occur. For example, scoring or losing a point can alter the emotion that an athlete experiences (Fritsch et al., 2020; Seve et al., 2007). In-competition, context-specific measurement of athlete emotion allows for a greater degree of measurement accuracy, specificity and the opportunity for multiple emotion assessments to occur (Campo et al., 2019; Campo et al., 2018; Freemantle et al., 2021). In this study an in-competition emotion measurement method was utilised during doubles table tennis matches to assess instances of within-dyad emotional aggregation and convergence.

Researchers have previously undertaken real-time assessment of transient athlete emotions using questionnaires (see Freemantle et al., 2021; Totterdell, 2000; Van Kleef et al., 2019) and facial expression analysis (Hetland et al., 2018). In the absence of in-competition measures, post-competition methods have been used to assess the prevalence, antecedents and consequences of athletes' in-competition emotions. These methods include video-assisted recall (Martinet & Ferrand, 2009), qualitative interviewing (Neil et al., 2011), and post-competition recall (Vast et al., 2010). In some instances, these investigations have sought to identify the performers' experienced emotions (Hetland et al., 2018; Martinet et al., 2012), while other researchers have also focused on the effect that athletes' emotions may have upon both their subjective and objective performance (see Janelle et al, 2020 for review). For instance, increased athlete positive emotion has been found to be associated with both an improved subjective (Vast et al., 2010) and objective performance (Uphill et al., 2014). Uphill et al. (2014) highlighted the significant detrimental impact that negative emotions such as anger can have upon successful objective game involvements. Conversely, some researchers argue that the effect of anger can be both facilitative and debilitating for athletes

depending on the sporting context (Robazza et al., 2006; Woodman et al., 2009). Qualitative assessments with table tennis players have indicated that simpler relationships may exist between athletes' experienced emotions and their performance. Martinent and Ferrand (2015) found, using a sample of national level table tennis players, that athletes associated positive emotion with successful performance and negative emotion with performance dissatisfaction. Qualitative assessments of athletes' emotions have provided the field with useful insights, yet a quantitative assessment of athletes' emotion, completed during competition, as in the current study, affords a rich examination of the emotional states that athletes experience and an objective understanding of how these transient emotional states may affect subsequent performance.

The above evidence and the majority of the 'emotions in sport' literature, focuses on the effect of individual athletes' emotional states on an outcome measure relevant to the individual. Yet, researchers are increasingly cognisant of social-functional approaches to emotion (Friesen et al., 2020; Van Kleef et al., 2019; Wagstaff & Tamminen, 2021). It is recognised that athletes' emotions do not develop in a vacuum and emotional experiences occur as a result of the social environment in which the athlete is situated (see Tamminen & Bennett, 2017). In social contexts, emotions may help to communicate intentions and serve as deterrents, as well as strengthen group bonds and define social boundaries (Wagstaff & Tamminen, 2021). Although an emotion is experienced individually, any emotional expression is likely to be public in its display, thus influencing those individuals in proximity. This influential emotional environment is a key facet of the Emotions as Social Information Model (EASI; Van Kleef, 2009). In his EASI model, Van Kleef explains that emotional expressions can cause affective, cognitive and subsequent behavioural reactions in observers. Evidence that athletes experience interpersonal affective relationships has been presented in support of the EASI model and researchers have reasoned that the emotions felt during sport,

especially team sports, should be considered social phenomena because they arise out of interactions rooted in social connections (Tamminen & Bennett, 2017). Moreover, the consistent social emotional communication that athletes experience with teammates has been shown to lead to the generation of collective team emotions through interpersonal emotional transfer (Tamminen et al., 2016; Wolf et al., 2018). Collective emotions are defined as the synchronous convergence of affect across individuals in response to a specific event (von Scheve & Ismer, 2013). Tamminen et al. (2016) found evidence for these collective emotions in a qualitative assessment of student athletes' emotional experiences and stated that collective emotions can be both positive and negative and can serve facilitative functions, such as a contribution to social bonds. Totterdell (2000) was the first to investigate the concept of social affect within a sports team. He found quantitative evidence for collective affective states within cricket players on the same team and showed that an athlete's positive mood was significantly related to that of their teammates. Totterdell (2000) proposed that this emotional association occurred because of social phenomena, rather than simply the athletes individually experiencing the same emotion in relation to the same events. Emotional contagion, the unconscious transfer of emotion between individuals in a group (Hatfield et al., 1994), was used by Totterdell to explain this interpersonal affective association. Emotional contagion also encompasses collective emotions which arise because of a conscious appraisal of another's emotional state rather than just the unconscious 'primitive' emotional contagion (Barsade et al., 2018). This transfer of emotion can be facilitated by tone of voice, physiological factors and facial expressions. The contagious effect of these behaviours is understudied in sport, although researchers have suggested that athletes are adept at the identification of other athletes' positive and negative non-verbal emotional expressions (Drewes et al., 2020; Friesen et al., 2013), an essential cornerstone of emotional contagion. In addition, Rumbold et al. (2021) found evidence of collective emotions in soccer

teams following a match, and, although not in an intra-team format, emotional contagion has also been described as present in relationships between opposing soccer players (Moll et al., 2010) and in coach-athlete relationships (Cotterill et al., 2020). These studies highlight further evidence that sport provides the necessary environmental and individual characteristics to cause inter-personal emotional aggregation through emotional contagion. Quantitative evidence for the presence of intra-team emotional aggregation has therefore been presented for larger teams during matches (viz., cricket, Totterdell, 2000), yet evidence for the existence of the concept within sports dyads, has not been previously examined. This is important as dyadic disciplines are common across a range of sports, and informal dyad relationships also exist in larger sports teams (e.g., the scrum half and fly half in rugby, or the two sweepers in curling). Evidence is required to better understand the within-dyad social emotional influence that sport partners can demonstrate. In addition, Totterdell (2000) remains the only study which features an assessment of intra-team emotional aggregation during a sports match. Therefore, further assessment of specifically in-competition collective emotional states is necessary. The current study, a quantitative investigation to assess collective emotions in collaborative table tennis pairs, was designed to highlight the role that social relationships play in the development and transfer of in-competition emotions in athlete dyads.

Dyads are found across differing sporting contexts. For instance, dyadic relationships have been investigated in table tennis (Greenlees et al., 2005), tennis (Lausic et al., 2009) and volleyball (Wickwire et al., 2004). Sporting dyads consist of two individuals with ambitions toward a shared competitive goal and who have shared experiences of the same events. Consequently, these pairs often engage in extensive communication while competing and a substantial amount of this intra-dyadic communication is emotional in nature (Lausic et al., 2009). Indeed, table tennis offers multiple opportunities for intra-pair communication

throughout a match as a result of the teammates' close proximity and the frequent pauses between points that often involve an explicit outward emotional reaction (Fritsch et al., 2020; Poizat et al. 2009). Relevant here is that observers have been shown to correctly categorise table tennis athletes' post-point emotional reactions as either emotionally positive, neutral or negative, indicating that these outward emotional reactions can be unambiguous in nature (Fritsch et al., 2020). Instances of non-verbal emotional communication between table tennis players throughout matches, not solely between points, have also been shown to impact the in-competition cognitions and expectations of athletes (Greenlees et al., 2005). A qualitative investigation completed by Poizat et al. (2009) showed that a table tennis pair consistently communicated both verbal and non-verbal information while competing. Approximately 85% of this communicated information was relevant to the collaborative partnership and most of the information was symmetrically communicated (i.e., the pair were communicating similar information at similar times). These frequent instances of intra-team communication, which are often distinctly emotional, may provide the necessary opportunities for the development of collective emotions and emotional convergence in table tennis partnerships through both unconscious and conscious emotional contagion. Nonetheless, no studies have previously investigated how an athlete's emotional state may affect that of their performance partner.

The aim of the present study is therefore to investigate the effect that athletes' emotional states may have on their partners' emotions while competing in table tennis matches as a dyad. Social-functional approaches to athlete emotions (Van Kleef, 2009; Friesen et al., 2020) were considered in the investigation of this aim. Owing to doubles athletes' repeated exposure to each other's emotional expressions (Poizat et al., 2009; Fritsch et al., 2020), as well as evidence of emotional aggregation in other sports (Rumbold et al., 2021; Totterdell, 2000), it was predicted that the dyad pairs would present an aggregated emotional state following periods of collaborative competition. It was also expected that the

athletes' emotional states would vary as a function of match (positive/negative) situation, and for individual emotional states to affect subjective and objective performance.

3.3 Methods

3.3.1 Participants

Sixty-eight male amateur table tennis players (34 dyads) competing in competitive doubles league matches were recruited. The average age of the sample was 31 years ($SD = 13.3$ years) and the pairs had, on average, competed together in 3 matches in the year prior to the study (range of 0 matches to 10 matches). In order to detect a medium to large effect size with 80% power for the comparison of the emotions experienced across the three match performance groups, G*Power suggested that a sample size of 66 participants was required. A sample size of approximately 29 dyads was needed to detect an intra-class correlation coefficient value of between .4 and .5 with 80% power and .05 alpha level (Bujang & Baharum, 2017). Actor-Partner Interdependence Models (APIM) are suited to smaller sample sizes and APIMs have been found to adequately detect differences in smaller sample sizes than those presented in this analysis (see Tambling et al., 2011).

3.3.2 Design

A three-time point (pre-competition, in-competition, and post-competition) longitudinal questionnaire design was used in this study to assess athletes' emotions across a table tennis match. Analyses were run to examine the differences in emotion intensity across time and match performance. Additionally, the within-dyad emotional aggregation was assessed at each of the three time points. This design allowed for a deeper examination of the athletes' emergent collective emotional experiences and considered the transience of sporting emotion (Campo et al., 2018).

3.3.3 Measures

Emotion

The athletes' emotional states were measured using the Brief In-Competition Emotion Scale (BICE: Freemantle et al., 2021). The BICE scale has been developed for the assessment of athletes' in-competition emotions and evidence has been presented to support the validity of this scale (Freemantle et al., 2021). The 10-item questionnaire measures emotion across the five principal factors of anxiety, happiness, dejection, excitement and anger and uses a 5-point Likert scale ranging from 0 (*Not at All*) to 4 (*Extremely*). All five of the emotion factors presented a McDonald's Omega reliability score of above .7 across the three data collection time points.

Subjective Performance

The participants were asked to rate how well they believed they were playing and how well they thought their pair were collectively playing using separate 70mm visual analogue scales ranging from *Poor* to *Excellent*. Similar measures of subjective performance have been utilised within the literature (e.g., Arnold et al., 2018; Levy et al., 2011). The athletes were also asked to provide an insight into how likely they thought it was that they would win the match. A 70mm visual analogue scale anchored at *Very Unlikely* and *Very Likely* was used for this measure. This is a similar methodology to that used in Totterdell (2000) which included a favourableness of match situation rating scale.

Objective Performance

The athletes' objective performance was operationalised as the number of points the pairs' opponents had scored subtracted from the number of points the participant pair had scored. A negative score indicated that the participants had lost more points than they had won. Points difference has been shown to be a useful indicator in predicting athlete performance and the likelihood of winning matches (Barreira et al., 2016).

Susceptibility to Emotional Contagion

The Contagion of Affective Phenomena Scale (Clarkson et al., 2021) was used to assess the participants' susceptibility to experiencing emotional contagion. The scale includes 29 items using a 5-point Likert scale ranging from 1 (*Never True*) to 5 (*Always True*). An overall susceptibility score can be calculated, as well as a positive emotion susceptibility score (McDonald's Omega = .836), a negative emotion susceptibility score (McDonald's Omega = .883) and a general susceptibility score (McDonald's Omega = .902). Positive emotion susceptibility is measured using items such as "When people around me are buzzing with excitement, I get excited too", while examples of an item assessing negative emotion susceptibility include "I feel tense when those around me are worrying about something". General emotion susceptibility is assessed using items such as, "Other people's emotions impact my own emotions".

3.3.4 Procedure

The participants provided informed consent before beginning their doubles table tennis match. All of the questionnaires were administered by the Principal Researcher and were completed using pen and paper. The first data collection time point occurred approximately 10 minutes before the match commenced. At this pre-competition time point (Time 1), the participants completed the BICE scale and an assessment of the likelihood that they would win the match. The second data collection point (Time 2) was undertaken in the one-minute allotted break in play between the second and third games during the match. The participants completed the BICE scale, a subjective assessment of their own performance, their collaborative performance as a pair and the likelihood that they would win the match. Following the completion of the match, the participants then immediately took part in the third data collection session (Time 3). Here the participants completed their final BICE scale assessment and a subjective assessment of their own performance and their collaborative pair performance since Time 2. Within approximately 30 minutes of the post-competition time

point, the participants completed the Contagion of Affective Phenomena Scale (Clarkson et al., 2021). Institutional ethical approval was granted for this study (SFEC 2019-066 see Appendix C).

3.3.5 Data Analysis

First, separate repeated measures ANOVAs were run to investigate how each of the five athlete emotional states changed over time (pre-, in- and post-competition). A single mixed ANOVA was also run to assess whether the BICE scale emotion factors were experienced at different intensities by participants who were winning, drawing or losing at Time 2 and those who had won or lost at Time 3. In these ANOVA models, the within subjects variable was emotion (anxiety, happiness, dejection, anger and excitement) and the between subjects variable was the match performance (winning, drawing or losing and won or lost). In addition, an ANCOVA model was completed which examined the relationship between the five measured emotions at Time 1 and Time 2 with subsequent objective performance (between-subjects), while controlling for the athletes' objective performance at the time of emotion measurement. Regression analyses were run to measure the effect of emotion on subjective personal performance. All statistical assumptions were met for each of the analyses that were run.

The emotional aggregation exhibited by the dyad pairs was assessed using an Actor-Partner Interdependence Model (Kenny et al., 2006). A partial intraclass correlation coefficient (ICC) was calculated for the dyads' five emotional states at Time 2 and Time 3 while controlling for the athletes' objective (the pairs' points difference at the time of emotion measurement) and subjective (the self-assessment of the pair's collaborative performance) experiences of the match at the time. These two variables were chosen so as to remove residual emotional similarity which may have occurred as a result of the partners' shared match environment. Significant ICC values have previously been used to indicate

empirical support for aggregation (Bartel & Saavedra, 2000; Kenny & LaVoi, 1985). The interdependence of the emotion scores was also assessed, such that any unexplained variance in the similarity of the dyads' emotion scores indicated the existence of an emotional aggregation which did not occur as a result of the participants experiencing the same match characteristics.

3.4 Results

3.4.1 Performance Correlations

The correlations between the objective and subjective performance measures for both Time 2 and Time 3 can be found in Table 3.1. The participants' subjective assessments of their performance and their collaborative pair performance was highly correlated with their objective performance at both Time 2 and Time 3.

Table 3.1

Bivariate Spearman's Rho Correlations between Subjective and Objective Performance Measurements taken at Time 2 and Time 3

Variable	1	2	3	4	5	6
1. Time 2 Objective Performance	-					
2. Time 2 Subjective Personal Performance	.594**	-				
3. Time 2 Subjective Collaborative Performance	.625**	.651**	-			
4. Time 3 Objective Performance	.691**	.419**	.550**	-		
5. Time 3 Subjective Personal Performance	.510**	.579**	.609**	.587**	-	
6. Time 3 Subjective Collaborative Performance	.416**	.343**	.590**	.694**	.803**	-

Note. $N = 68$

** $p < .01$

3.4.2 Emotional Experiences

Table 3.2 presents the means, standard deviations and group differences of the five emotion factors at all three data collection time points. Post hoc Bonferroni pairwise comparisons showed that athlete Happiness at Time 1 was significantly higher than at Time 2. Athlete Anxiety was significantly higher at Time 1 and Time 2 than at Time 3. The athletes experienced significantly less Dejection at Time 1 compared to Time 2 and Time 3 and the same pattern was found when comparing Anger at Time 1, Time 2 and Time 3. The only significant difference between time points for Excitement was between Time 1 and Time 2.

A mixed factorial ANOVA assessing the effect of match situation and emotion factor on emotional intensity was completed for Time 2. Table 3.3 shows the means, standard deviations and confidence intervals while Table 3.4 shows the ANOVA results. Bonferroni corrected pairwise comparisons were also completed. Happiness scores were significantly lower for those athletes losing compared to those winning. The athletes felt significantly less dejected when winning and drawing compared to when losing. Additionally, the athletes were significantly less angry when winning compared to when losing. There were no significant differences in Excitement or Anxiety scores whether winning, drawing or losing.

A second mixed factorial ANOVA was conducted to examine whether the athletes' post-match emotions differed at Time 3 dependent upon whether they had won or lost the match. A significant main effect was found for emotion, $F(1.80, 118.91) = 56.03, p < .001, \eta_p^2 = .46$, and a significant main effect was found for match performance, $F(1, 66) = 5.48, p = .022, \eta_p^2 = .08$. The interaction effect was also significant, $F(1.80, 118.91) = 33.28, p < .001, \eta_p^2 = .36$. Bonferroni corrected pairwise comparisons were again run to assess this significant interaction effect and all five emotion factors were shown to present significantly different emotional intensities whether the athlete had won or lost the match (see Table 3.5).

Table 3.2*Descriptive Statistics and Group Differences for each of the Five BICE Scale Emotions at Time 1, Time 2 and Time 3*

Emotion	Time 1		Time 2		Time 3		Differences across Time
	Mean	SD	Mean	SD	Mean	SD	
Happiness	5.38	1.76	4.60	2.30	4.90	2.41	$F = 4.27, p = .02$
Anxiety	1.63	1.62	1.76	1.75	.93	1.67	$F = 8.80, p < .001$
Dejection	.91	1.59	1.96	2.09	2.59	2.79	$F = 15.15, p < .001$
Excitement	4.38	1.69	5.51	1.87	5.07	2.15	$F = 8.74, p = .001$
Anger	.94	1.54	2.19	2.29	2.35	2.59	$F = 13.05, p < .001$

Note. $N = 68$

Table 3.3*Descriptive Statistics for each of the Five BICE Scale Emotions whether Winning, Drawing or Losing at Time 2*

Emotion	Winning			Drawing			Losing		
	Mean	SD	Confidence Intervals	Mean	SD	Confidence Intervals	Mean	SD	Confidence Intervals
Happiness	5.55	2.40	[4.60, 6.50]	4.54	2.02	[3.67, 5.41]	3.65	2.23	[2.66, 4.64]
Anxiety	1.00	1.23	[.28, 1.72]	2.04	1.51	[1.38, 6.70]	2.25	2.24	[1.50, 3.00]
Dejection	.96	2.40	[.15, 1.76]	1.77	1.48	[1.03, 2.51]	3.30	1.75	[2.45, 4.15]
Excitement	5.66	1.90	[4.99, 6.56]	5.81	1.77	[5.08, 6.53]	4.85	1.90	[4.02, 5.68]
Anger	1.23	2.49	[.29, 2.16]	2.27	1.93	[1.41, 3.13]	3.15	2.29	[2.17, 4.13]

Note. $N = 68$

Table 3.4

ANOVA Results Table for the Differences in Emotion Intensity Across Different Emotion Factors and Match Situation

Source	df	MS	F	p	Effect Size
Emotion Factor (A)	1.79	116.15	50.63	<.001	.44
Match Situation (B)	2	65	1.94	.152	.06
A × B	3.57	116.15	4.94	.002	.13

Table 3.5

Descriptive Statistics for each of the Five BICE Scale Emotions at Time 3 Whether the Athlete had Won or Lost the Match

Emotion	Won			Lost		
	Mean	SD	Confidence Intervals	Mean	SD	Confidence Intervals
Happiness	6.24	2.06	[5.55, 6.92]	3.56	1.96	[2.87, 4.25]
Anxiety	.50	1.05	[-.06, 1.06]	1.35	2.04	[.80, 1.91]
Dejection	.82	2.04	[.08, 1.56]	4.35	2.28	[3.61, 5.10]
Excitement	5.97	1.78	[5.30, 6.65]	4.18	2.14	[3.50, 4.85]
Anger	.94	2.09	[.19, 1.69]	3.77	2.27	[3.02, 4.51]

3.4.3 Emotions and Performance

Subjective Performance

Regression analyses were completed to investigate whether each of the emotion factor scores at Time 1 could predict subjective performance assessments made at Time 2. While controlling for the participants' pre-match assessments of their likelihood of winning, only the participants' levels of pre-competition Excitement had a significant additional predictive impact upon subjective personal performance levels at Time 2 (Beta = .262, $p = .011$, R^2

change = .080). These findings suggest that increased levels of pre-competition Excitement were related to higher subjective in-competition performance.

Similar regression models were then completed to assess the effect of the participants' Time 2 emotion on their subsequent subjective personal performance while controlling for the Time 2 assessment of their likelihood of winning the match. The participants' during match Anxiety (Beta = $-.277$, $p = .015$, R^2 change = .078), Dejection (Beta = $-.309$, $p = .005$, R^2 change = .100) and Anger (Beta = $-.230$, $p = .018$, R^2 change = .073) all contributed a significant additional effect to their subjective personal performance assessments. Time 2 Anxiety (Beta = $-.221$, $p = .037$, R^2 change = .048), Dejection (Beta = $-.223$, $p = .020$, R^2 change = .059) and Anger (Beta = $-.191$, $p = .021$, R^2 change = .058) also significantly predicted Time 3 subjective performance when Time 2 points difference was instead controlled for.

Objective Performance

Table 3.6 shows the ANCOVA results assessing the effect of Time 2 emotion on subsequent objective performance (won or lost) while controlling for the participants' objective points difference at Time 2. The main effect for both emotion factor and match performance were shown to be significant, and the interaction effect was non-significant. Bonferroni corrected pairwise comparisons showed that only Time 2 Anxiety was significantly different for the participants who subsequently won or lost the match. The participants who lost ($M = 2.44$, 95% CI [1.76, 3.12]) were found to have been experiencing more Anxiety at Time 2 than those who won ($M = 1.09$, 95% CI [.67, 1.50]).

Table 3.6

ANCOVA Results Table Showing the Differences in Emotional Intensity across Match Performance at Time 3 and Emotion Factor while Controlling for Objective Points Difference at Time 2.

Source	df	MS	F	p	Effect Size
Emotion Factor (A)	1.76	114.05	49.68	<.001	.43
Match Performance (B)	1	65	.53	.008	.11
A × B	1.75	114.05	1.46	.237	.29

3.4.4 Emotional Aggregation

At Time 2, both dyad Happiness (ICC = .488, $p < .001$) and Dejection (ICC = .395, $p = .008$) presented significant within-dyad partial ICC values. This was consistent with the prediction that the dyad pairs would experience emotional aggregation and present a collective team emotion. Of the within-dyad variance, 75.1% of the Happiness variance and 69.4% of the Dejection variance was not explained by the comparative subjective and objective match contexts that both members of the dyad were experiencing simultaneously. Owing to these findings, and previous evidence from the literature, socially facilitated interpersonal emotional transfer may have been a process which assisted in creating this within-dyad collective emotional state.

In additional support of the predictions, at Time 3, Happiness (ICC = .539, $p < .001$), Dejection (ICC = .491, $p = .001$) and Anger (ICC = .518, $p < .001$) scores all presented significant within-dyad partial ICC scores when controlling for the athletes subjective and objective experiences of the match at the time. Further, the within-dyad emotional variance not explained by athletes' subjective or objective performance was 62.1% for the Happiness scores, 55.7% for Dejection scores and 61.2% for Anger. Consequently, large proportions of

the within-dyad emotional variance were caused by factors other than the shared match experiences and may therefore have been facilitated by interpersonal emotional transfer.

The partial ICC values were found to increase between Time 2 and Time 3 for all of five measured emotions. These increases indicate that the athletes within the same dyads presented a more similar emotional state as the match progressed, thus suggesting emotional convergence. The ICC values can be found in Table 3.7.

Table 3.7

The Partial ICC values for all Five Emotions at Time 2 and Time 3.

Emotion	Time 2 partial ICC Value	Time 3 partial ICC Value
Happiness	.488*	.539*
Anxiety	.227	.266
Dejection	.395*	.492*
Excitement	.004	.189
Anger	.288	.519*

*p<.05

3.4.5 Emotion Aggregation and the Contagion of Affective Phenomena Scale

The participants recorded an average overall emotional contagion susceptibility value of 2.88 ($SD = .50$), an average positive emotional contagion susceptibility score of 3.63 ($SD = .56$) and an average negative emotional contagion susceptibility score of 2.52 ($SD = .56$). The same APIM models from the aggregation analysis were run with the Contagion of Affective Phenomena Scale (CAPS) scores also included as a predictor. Significant increases in the variance explained by the models after the addition of the CAPS scores would suggest that the participants' subjective assessments of their susceptibility to experience emotional contagion contributed to explaining any within-dyad emotion similarity. The addition of the CAPS scores significantly increased the variance explained by the APIM model for the

within-dyad Happiness scores by 8.5% at Time 2 and by 18.9% at Time 3. The inclusion of the subjective CAPS scores in the model for Dejection at Time 2 and Time 3, and for Anger at Time 3 did not significantly affect the variance explained by the model.

3.5 Discussion

In this study, the emotional experiences of doubles table tennis players were examined using an in-competition emotion measurement technique. The emotions that the athletes' experienced throughout their matches were highlighted, as well as the impact that these emotions had upon the athletes' subjective and objective performance. In addition, evidence of within-dyad emotional aggregation was presented at both the in-competition and post-competition time points.

In general, the results of the present study act to support the current literature suggesting that athletes experience more negative emotions when losing or following a loss and they experience more positive emotions when winning or following a win (see Jones & Sheffield, 2007; Polman et al., 2007). These results also support the qualitative findings presented by Seve et al. (2007) and Martinent and Ferrand (2015), who showed that table tennis players experience more pleasant and fewer unpleasant emotions when winning games and vice versa when losing games. Nevertheless, in contrast to those studies, the findings here represent a quantitative assessment of table tennis athletes' in-competition emotions. The novel in-competition methodology used in this research provides further evidence of the transient emotions which Campo et al. (2018) suggest are experienced by athletes in-competition, but which have not previously been quantitatively assessed. To extend this work, researchers might continue to adhere to the methodological recommendations outlined by Wagstaff and Tamminen (2021) regarding the necessity for in-competition assessment when measuring in-competition athlete emotion.

Another objective of the present study was to assess the effect of the five measured emotions on the athletes' subjective and objective performance. It was found that pre-competition excitement positively impacted future subjective performance while in-competition anxiety, dejection and anger each negatively affected future subjective performance measures. Despite some previous researchers providing evidence to indicate that negative emotions can be facilitative in certain sports (Robazza et al., 2006), the present findings suggest that negative emotions are in fact debilitating when experienced during table tennis matches. All three Time 2 negative emotions significantly predicted poorer subjective performance assessments at Time 3. The athletes' decrease in subjective performance assessments may have occurred because of maladaptive cognitive appraisals impacting on the athletes' attitude towards their own performance through cognitively exaggerating the athletes' mistakes and ignoring their successful actions (Nicholls et al., 2012). Subjective performance was also highly correlated with objective performance, further highlighting the importance of seeking to improve athletes' emotional states.

Interestingly, only in-competition anxiety was associated with a reduction in the athletes' subsequent objective performance. The effect of state anxiety on objective sporting performance has been widely examined, with the vast majority of studies indicating, similarly to the results of the present study, that more intense experiences of anxiety lead to poorer performance (see Woodman & Hardy, 2003). Nevertheless, the objective performance measure that was used here (a win or a loss) was as much a measure of the participants' pair performance as the participants' own performance. Therefore, that individual level subjective anxiety was shown to relate to a pair level objective performance measure, indicates the full extent of the impact that experiences of state anxiety can have on athletes' performance.

The key aim of the current study was to investigate the effect of an athlete's emotion on their partner's emotional state and identify any instances of collective emotions.

Collective emotions are identified as synchronous emotional states exhibited across individuals in response to a stimulus (von Scheve & Ismer, 2013). It was shown that at Time 2 (between game 2 and 3 of the match) the athletes' within-dyad experiences of happiness and dejection were significantly related, and at Time 3 (immediately following the match) within-dyad happiness, dejection and anger were significantly associated. These results indicate, in support of the hypothesis, that collective happy, dejected and angry emotional states were experienced by the collaborative dyads. This represents the first evidence of this phenomenon in dyadic sport.

The significant association between the paired athletes' happiness scores directly supports Totterdell's (2000) study which found that cricket players' happiness was related to the happiness of their teammates regardless of the match situation and any personal hassles. In Totterdell's study, this relationship was only identified when individuals were feeling happier than usual, rather than when they were feeling unhappy (the opposite anchor on the hedonic scale that Totterdell used). Yet, in the present study, within-dyad collective emotion was also found for participants' in-competition experiences of dejection and anger, indicating that negative emotions may also aggregate in sports teams and lead to collective emotional states.

In this analysis, the within-dyad happiness, dejection and anger emotional aggregation was present whilst controlling for the pairs' objective and subjective experiences of their match performance. As a result, similarly to Totterdell's (2000) study, it can be assumed that some portion of the demonstrated collective emotional states were not established simply as a result of the pair experiencing the same events simultaneously. Owing to previous research indicating that interpersonal emotional transfer may be present in sport (Cotterill et al., 2020; Rumbold et al., 2021; Totterdell, 2000), and evidence that small-sided collaborative teams can experience emotional contagion when undertaking collaborative tasks (Ilies et al., 2007),

it was hypothesised that the emotional aggregation highlighted in this study occurred, in part, as a result of emotional contagion (Hatfield et al., 1994). Emotional contagion is the interpersonal transfer of affect, facilitated by facial expressions, tone of voice, gestures and other behaviours (Barsade et al., 2018). In support of this theory, the socially intense environments that sport fosters have been shown to lead to both explicit emotional expressions and subtle, nuanced emotional indicators (Fritsch et al., 2020; Lausic et al., 2015; Poizat et al., 2009; Tamminen et al., 2016). Indeed, happiness and dejection are two emotions that are easily expressed and identified (Keltner et al., 2019), which may suggest why these two emotions showed a significant within-dyad association at the in-competition time point and the post-competition time point. It is suggested that expressions of excitement and anxiety, when compared to happiness and dejection, may not be so easily demonstrated and identified by individuals, which explains why these emotions did not elicit a significant partial ICC score. Nevertheless, expressions of anger are often frequently explicitly exhibited in sport (Gonzalez-Garcia et al., 2019), hence it is not a surprise that at Time 3, anger was shown to also significantly aggregate within the pair. Hatfield et al. (2014) previously stated that emotional experiences must be of suitable intensity for emotional contagion to occur and therefore it seems that the emotional intensity threshold for anger was met at Time 3 following an increase in the average anger intensity from Time 2.

The within-dyad emotional aggregation was found to increase for all of the five emotions as the match progressed. The significant aggregation of Happiness and Dejection at Time 2 and then Happiness, Dejection and Anger at Time 3 indicates that the pairs experienced emotional convergence and their emotional states became more similar over time. This is the first explicit evidence of longitudinal emotional convergence during sporting competition and extends previous studies which have either not addressed the changes in

within-team emotional similarity over time (Totterdell, 2000) or have only measured within-team emotion aggregation at a single time point (Rumbold et al., 2021).

The Contagion of Affective Phenomena Scale (Clarkson et al., 2021) was also found to significantly increase the explained variance in the athletes' within-dyad happiness aggregation. The CAPS may therefore provide a useful indication as to individuals' tendencies to experience interpersonally aggregated emotions and may act as a predictor for the likelihood of athletes experiencing social emotional transfer. This is the first time that this scale has been used in an applied assessment of emotional aggregation and further research is encouraged to assess the role that the CAPS may play in predicting emotional contagion.

Regarding limitations, the naturalistic approach that was implemented in this study may have acted as a limitation in presenting evidence of emotional contagion as it was not possible to manipulate the participants' emotions and the events that they experienced (see arguments proposed by Totterdell, 2000). Instead, as a result of this design, I utilised an analysis technique which provided evidence of within-dyad emotional aggregation and cases of unexplained emotional similarity. As such, this analysis demonstrated evidence of collective emotional states (von Scheve & Ismer, 2013), although the exact causes of these collective emotions are not explicitly clear. Nevertheless, the athletes' objective and subjective experiences of the match were controlled for in the calculation of emotional aggregation, which would suggest that the collective emotions did not occur because of the pairs' simultaneous experiences of match events. In addition, owing to the frequent emotional communication that sporting dyads have been shown to demonstrate (Lausic et al., 2009), as well as the largely symmetrical information sharing in table tennis doubles pairs (Poizat et al., 2009), it is probable that the required characteristics, such as emotional intensity and clear emotional expression, were present for within-dyad collective emotions to occur through interpersonal emotional transfer. Future researchers may wish to conduct experiments which

manipulate the emotions of sporting teams before competition to provide further evidence of emotional transfer. Nevertheless, such a manipulation would be difficult to achieve in sporting competition and would include an ecological validity cost.

In sum, within-dyad associations in athlete emotion were found for the emotions of happiness and dejection, in-competition, and happiness, dejection and anger post-competition. Previous researchers have found evidence for the presence of emotional aggregation in a range of relationships within sport (e.g., *coach-athlete* Cotterill et al., 2019; *opponent-opponent* Moll et al., 2011; *large group teammates* Totterdell 2000) and the wider literature has shown that the emotions experienced within sport are socially relevant and interpersonally influential (Tamminen & Bennett, 2017; Van Kleef et al., 2019). The evidence presented in this study therefore provides support for social-functional theories of emotion within sport and further indicates the effect that teammates' emotional displays can have upon other's cognitive and affective states (Van Kleef, 2009). Evidence here has shown that athletes should be wary of negative emotions being transferred within teams, as well as hopeful for the transfer of positive emotion.

This examination of table tennis dyad members' in-competition emotional states has highlighted the salient emotions that athletes experience throughout matches and the collective nature of these emotions. I argue that the presented collective emotions may occur, in part, because of emotional contagion. These findings support previous research investigating interpersonal emotional phenomena and provide further evidence that individuals' emotions are interpersonally relevant in social situations.

Chapter 4: The Relationship Between Olfactory Function and Emotional Contagion

This chapter draws from the following manuscript:

Freemantle, A.W.J., Stafford, L.D., Wagstaff, C.R.D., & Akehurst, L. (2021). The relationship between olfactory function and emotional contagion. *Chemosensory Perception*, Advance Online Publication. <https://doi.org/10.1007/s12078-021-09293-4>

4.1 Abstract

Research has provided evidence for the transfer of single emotions including anger, anxiety and happiness through olfactory chemosignals, yet no work has examined the role of odour function in the aggregation of more complex emotional states or in the emotional contagion process. The aim of the present study was to ascertain whether an individual's tendency to experience emotional aggregation was affected by objective measures of their olfactory function and subjective self-assessments of the importance of their own olfactory system. In this study ($N = 70$), participant pairs were first assessed individually for olfactory threshold and odour identification, then completed the Importance of Olfaction Questionnaire. Each pair subsequently took part in two collaborative tasks. Individual emotion measures were taken before, during and after the completion of the two tasks. Multilevel structural equation modelling revealed that individuals' within-dyad positive emotional agreement scores were associated with both their 'importance of olfaction' scores and their olfactory function. A significant association was also found between olfactory performance and the Importance of Olfaction scores. These results provide evidence that the subjective importance an individual assigns to their sense of smell can predict their susceptibility to experience emotional aggregation during active, collaborative tasks. The findings suggest that individuals' tendency and capability to detect and respond to emotional chemosignals, a process required for olfactory facilitated emotional contagion, may be affected by individual differences in olfactory function and subjective attitudes towards olfaction.

4.2 Introduction

Social communication can be facilitated through visual, auditory and olfactory sensory modalities. Indeed, olfaction has been shown to possess multiple advantages for communication (Pause, 2012). To elaborate, the social communication benefits of the olfactory system exist, in part, as a result of the production and detection of chemosignals. Human chemosignals can be found in bodily secretions such as tears (Gelstein et al., 2011) and sweat (Chen & Haviland-Jones, 2000) and can relay information relating to an individual's age, health, gender, social connection and emotional state (de Groot et al., 2017; Lubke & Pause, 2015). Seminal research undertaken by Chen and Haviland-Jones (2000) provided evidence that the experience of different emotions can cause the production of identifiable chemosignal profiles. Chen and Haviland-Jones also showed that these emotionally descriptive chemosignals could be detected, identified and differentiated using the olfactory system. Moreover, recent research has shown the detection of these emotion-related chemosignals can cause a subsequent change in a detector's emotional state in response to a donor's emotional state (see de Groot et al., 2017). In the current research I sought to examine the role of individual differences (i.e., olfactory function, consisting of olfactory threshold and identification, and individuals' perceived importance of olfaction attitudes) in the olfactory facilitated emotional transfer process. Identifying individual differences in the detection and processing of olfactory emotional chemosignals will allow for a more detailed explanation regarding the mechanisms by which these chemosignals can influence other individuals. This greater understanding will assist researchers in examining the concept and provide a basis for real-world manipulation.

4.2.1 Olfactory Function

The detection of stimuli containing either social or non-social odours requires processing within the primary level of the olfactory system (de Groot et al., 2012; Tirindelli

et al., 2009). One useful index of this detection is the use of olfactory threshold sensitivity tests. Olfactory sensitivity is related to a broad range of neurological processes including eating behaviour (Palouzier-Paulignan et al. 2012) and emotion (Pollatos et al., 2007; Stafford & Wellbeck, 2011). For instance, for the latter, it has been shown that increases in negative mood are inversely related to olfactory sensitivity (Pollatos et al., 2007; Stafford & Wellbeck, 2011). Additional evidence has also been presented which has shown a relationship between individuals' olfactory performance and their aptitude for higher order executive functioning (Hedner et al., 2010). Hedner et al.'s (2010) findings, coupled with the link between emotion and olfaction, raise the possibility that an individual's odour function may be found to impact upon the complex emotional chemosignalling process and thus an individual's susceptibility to experience emotional aggregation.

Haviland-Jones, McGuire and Wilson (2016) found that there existed three social odour detector groups (super-detectors, detectors and non-detectors) with regard to participants' accuracy in sorting donated odours into fear, happiness and control groups. These findings suggest that there may be a distribution of capability in identifying social odours in much the same way as individuals' non-social odour identification. Therefore, testing aspects of individuals' olfactory functioning, such as odour identification capabilities, could be an important facet in assessing their tendency to differentiate socio-emotional odours. Yet, Haviland-Jones and colleagues' study did not examine participants' ability to detect and emotionally respond to implicit emotional chemosignals - those originating from odours that participants are not explicitly told are socially relevant. As a result, it is still unclear how individual odour detection functions in real-world situations when individuals are presented with a cloud of olfactory noise containing both social and non-social odours.

4.2.2 Olfaction and emotion contagion

The discrimination of socio-emotional odours, though important, is only one part of the jigsaw and links to the question of whether once detected, chemosignals could have an emotionally contagious effect upon receivers' emotional states. Evidence for the emotional contagion (the unconscious interpersonal transfer of mood and affect, Hatfield et al., 1994) of singular emotions, as facilitated by the olfactory system, has been demonstrated throughout the literature across varying affect and methodologies (see de Groot et al., 2017 for review). Studies which have investigated the transfer of fear and anxiety through olfaction have predominately involved presenting participants with body odours collected from the axilla of donors. Researchers induce donors to feel anxious using methods such as academic exams (Prehn et al., 2006) and high ropes courses (Albrecht et al., 2011), and the effect that the presented chemosignals have upon the participant receiver may then be assessed through the exhibition of fearful facial expressions (de Groot et al., 2012) and subjective emotion measures (Albrecht et al., 2011). In these laboratory studies, the odour is explicitly presented to the receiver and detection of the odour is as controlled as possible. Nevertheless, Singh et al. (2018) found that dental students' procedural performance was worse when undertaking procedures on a mannequin dressed in a t-shirt that an anxious donor had worn. These findings show that an explicitly controlled proximity and odour presentation technique are not required for the olfactory detection of body odour and the identification of a subsequent emotionally contagious effect. Indeed, Singh et al. (2018) therefore provided evidence for the potential role of olfactory facilitated emotional communication in day-to-day human experiences, and even showed that these body odours were communicatively relevant when masked by other non-social odours (as they could be by deodorants or perfumes in real life).

In contrast to the negative emotion literature, the interpersonal transfer of positive emotional chemosignals remains understudied. This reduced attention may be due to the tendency to investigate the so called 'hot emotions' (see Fredrickson, 2003), despite the

experience of positive emotion being associated with evolutionary benefits (Fredrickson, 2001; Steptoe et al., 2005; Taylor et al., 2000), as well as advantages in social situations (Fredrickson, 2003). Increased positive emotions have been shown to improve immune function (Cohen, Doyle & Turner 2003) and increase interpersonal trust (Dunn & Schweitzer, 2005). Hence, a greater examination of the interpersonal transfer of positive emotions is necessary. Within the chemosignalling literature, research has shown that the body odour of a donor experiencing happiness can cause receivers to exhibit happier facial expressions when measured using EMG (de Groot et al., 2015).

In sum, the extant evidence can be interpreted to indicate that both positive and negative emotional chemosignals can cause interpersonal emotional transfer and affect receivers' emotions. Researchers have also shown that this interpersonal effect can occur in real-life scenarios in which odour proximity and detection is not explicitly controlled. The relationship between emotion and olfaction raises the question as to whether an individual's odour sensitivity and performance can impact upon the complex emotional chemosignalling process and thus an individual's susceptibility to experience emotion contagion.

4.2.3 Perceived importance of olfaction

Subjective attitudes toward olfaction may also affect individuals' tendency to detect and process social emotion-related chemosignals. For instance, the Importance of Olfaction Questionnaire (Croy et al., 2010: IOQ) measures individuals' attitudes toward the associations related to specific olfactory sensations and the tendency for one to use their sense of smell in daily social situations. Indeed, scores on the IOQ have been shown to correlate with social communicative factors such as an individual's tendency to exhibit socially conforming behaviours (Seo et al., 2013). Seo et al. presented evidence for a relationship between self-reported socially relevant personality traits with importance of olfaction scores. It was argued that the neuroanatomical convergence of olfactory and

emotional brain areas was a possible explanation for this finding. Additionally, Sorokowska et al. (2018) suggested that individuals paying more attention to the odours that they detected explained the evidence they found indicating the existence of individual differences in self-reported social odour awareness. This increased olfactory consideration may consequently lead to others' positive or negative olfactory chemosignals being more readily detected. Furthermore, evidence has been presented which highlights a positive relationship between an individual's attitudes towards their olfaction and their olfactory performance (Landis et al., 2003). In sum, it is suggested that measures of individuals' attitudes towards olfaction, such as the IOQ, may play an important role in how individuals experience social situations.

4.2.4 A Mix of Emotions

The methodology used in the majority of research in this area require donors to be induced into experiencing a specific intense emotion before their body odour is collected. Though an efficient methodology, this ignores the fact that human emotional experience is complex, featuring intertwining affect that is constantly fluctuating (Kuppens et al., 2010). The range of emotions that an individual may experience during these tasks will combine to form general emotional states which may, at times, offer additional relevant social information alongside any primary emotion. Yet researchers using the donor-receiver methodology in single emotion transfer studies inadvertently ignore this emotional complexity. As well as during the intense situations created in chemosignalling research, wider emotional states are experienced frequently in everyday life. These more general affective experiences may not prompt a fight or flight response, but nevertheless have been shown to influence others (Van Kleef, 2009) and support social communication (Lount, 2010; Waugh & Fredrickson, 2006). The frequency with which these emotional states are experienced, in addition to the social and evolutionary advantages, highlight the role that chemosignalling communication and the olfactory system may hold in their interpersonal

transfer. Nonetheless, it is not currently clear whether chemosignal profiles exist for these less intense, but commonly experienced, positive and negative general affective states.

4.2.5 The Current Study

The current study was conducted to move beyond the limitations of the sender-receiver model of odour donation/presentation and instead examined broader emotional aggregation in the chemosensory domain. The aim was to investigate the relationship between individual odour function (olfactory threshold sensitivity, olfactory identification), subjective measures of odour attitudes (Importance of Olfaction Questionnaire, IOQ) and a pair of individuals' emotional aggregation. It is tentatively predicted that participants who exhibited higher odour function would present higher emotional aggregation scores with their partner. As this reflects the first time that the IOQ has been used in chemosignalling work, the examination of the relationship of IOQ was more exploratory in nature.

4.3 Methods

4.3.1 Participants

Seventy participants (53 female and 17 male) were recruited to take part in this study. The participants' mean age was 19.4 years (SD = 2.3 years) and all participants reported being non-smokers and non-vapers. The participants were tested as 35 pairs of individuals known to each other (23 F/F dyads, 7 F/M dyads and 5 M/M dyads). Sample size was predetermined on the basis of recommendations for multilevel modelling (>30 participant clusters, per Maas & Hox, 2005; Scherbaum & Ferreter, 2009).

An adapted version of the Perceived Interpersonal Closeness scale (Popovic et al., 2003) was utilised to assess the subjective closeness of each pair relationship. The scale used a semi-circle structure with six concentric rings moving away from a centre point. The ring labels ranged from *Distant* to *Fully Close*. The participants were told that 'feeling close' was defined as, being listened to, understood by, able to share feelings with, and to talk openly

with their partner. Participants marked with a cross how close they felt they were to their partner. Perceived closeness was operationalised as the distance between this cross and the centre point. The mean perceived closeness of the participants with their partner was 3.61 cm ($SD = 1.39$) this equated to 'Very Close'. This closeness score was used as a control variable in the subsequent mediation model.

4.3.2 Measures

Olfactory Threshold

An olfactory threshold test was completed to measure the participants' olfactory threshold sensitivity. The odorant used in this threshold test was butanol which was diluted in deionised water. The odorant was prepared using sixteen amber bottles in 16 dilution steps starting at 0.125% (Step 1), with each successive step diluted by a factor of 2 using serial dilution to the lowest (Step 16). At each dilution step, the bottle containing the odour was accompanied by two 'blank' bottles containing only the dilutant. A widely used forced choice single up-down staircase method was utilised (see Hummel & Welge-Luessen, 2006). The threshold test was completed once there had been 7 turning points, with the mean of the last 4 turning points indicating a participant's threshold score. Each testing bottle was held 2cm below a participant's nose and waved below both nostrils to ensure optimal inhalation. The participants were instructed to wear a blindfold so as to avoid any identification of the odour bottles, and the experimenter wore cotton gloves to reduce odour cross contamination.

Olfactory Identification

The Sniffin' Sticks Identification test (Hummel et al., 1997) was used to assess the participants' odour identification ability. The test consisted of 16 pens which each contained the smell of a household odour. For each pen, the cap was removed by the experimenter and the pen tip was placed approximately 2cm below a participant's nostrils and waved left and

right to ensure optimal inhalation across both nostrils. For each pen, the participants selected the odour they believed to be correct from a set of four response options.

Importance of Olfaction Questionnaire

The significance that the participants placed upon odour and their olfactory behaviours was measured using the Importance of Olfaction Questionnaire (Croy et al., 2010: IOQ). The IOQ consists of three subscales: application, association and consequence. The application subscale measures an individual's subjective belief regarding the extent to which they use their sense of smell in their daily lives (e.g., I smell my clothes to judge whether I have to wash them or not). The association subscale measures how important participants believe that odour is in evoking memories, emotions and values (e.g., Certain smells immediately activate strong feelings). Finally, the consequence subscale represents the extent to which individuals believe that they use olfaction to make daily decisions (e.g., If my partner has a nasty smell, I avoid kissing them). Participants respond to each questionnaire item using a 4-point Likert scale ranging from 1 (*I totally agree*) to 4 (*I totally disagree*). The final IOQ score for each participant was calculated as the average of the three subscale scores, with high scores indicating that individuals regard the olfactory sense as having a large impact upon their lives.

Positive and Negative Affect Scale

The participants' emotional states were measured at four time points using the Positive and Negative Affect Scale (PANAS, McNair et al., 1971). This scale consists of 20 items, ten of which assess positive emotion and ten assess negative emotion. Participants responded on 5-point Likert scales (1 = *Not at all* to 5 = *Extremely*) regarding the extent to which they were experiencing the 20 emotions. Within-dyad emotional aggregation was measured by comparing either the positive emotion or negative emotion PANAS subscale scores for two members of the same dyad using an $r_{WG(j)}$ method.

Task Performance

The participants completed two sub-tasks during the task phase of the study. First, the subjects played Nintendo Wii Sports tennis (Nintendo) on the same team as their partner for 10 minutes, following this, the participants attempted to complete a jigsaw puzzle together for a further 10 minutes. Performance in the Wii Sports tennis task was operationalised as the number of points won subtracted by the number of points lost. Performance during the jigsaw puzzle task was operationalised as the number of puzzle pieces that were correctly connected to at least one other puzzle piece. These two tasks were chosen as the partners were required to cooperate in order to succeed, in addition, the two tasks differed in that they were either physically active (Wii Sports) or physically passive (jigsaw puzzle). Both tasks have been used extensively within the literature (e.g., Carrasco et al., 2019; Fessler et al., 2017).

4.3.3 Procedure

The participants were instructed to arrive at the testing venue with a friend. On arrival, they were taken to separate rooms and each participant completed a PANAS emotion measure (Time 1: the arrival time point) and the ‘closeness to partner’ rating scale. Following the completion of these measures, each participant undertook an odour threshold test, the odour identification test and the Importance of Olfaction Questionnaire. Once participants had completed these tests, they undertook a second PANAS emotion measurement in private (Time 2: the pre-task time point). The participants were then asked to come together for the collaboration tasks. They were briefly taught the Nintendo Wii gameplay controls and then played Wii Sports Tennis for 10 minutes on the same team against two computer generated players. After playing for 10 minutes, the participants were given another PANAS emotion measure to complete in their separate testing rooms (Time 3: the during task emotion measure). The participants then together attempted to complete as much of a jigsaw puzzle as possible for a further 10 minutes. Following the second collaborative task, the participants

were asked to complete a final PANAS emotion measure, again on their own, (Time 4: the post-task time point) before being debriefed and thanked for their time. These four emotion measurement time points were used as they each represented a different dyadic emotional significance. At the arrival time point, the two dyad members had not yet experienced any of the same events, at the pre-task time the two partners had experienced the same olfactory testing procedures but separately from each other, then, at the during task and post-task times the participants had experienced the same tasks together whilst working collaboratively. The study was approved by the institution ethics board (SFEC 2019-090 see Appendix C) and all participants provided written informed consent.

4.3.4 Statistical Analysis

Repeated Measures ANOVA analyses were carried out to assess the difference in emotional states across the four time points. The same technique was used to assess whether the emotion agreement scores significantly differed across time points. Intraclass Correlation Coefficients (ICC) were also calculated for both positive and negative emotion scores at all four data collection points using an Actor-Partner Interdependence Model (Kenny et al., 2006). ICC values present the extent to which participants' within-dyad emotion scores are similar when compared to the whole cohort's between-dyad emotion scores and thereby offer an index of emotional aggregation.

Multilevel Structural Equation Modelling mediation analyses were completed to ascertain whether the relationship between an individual's Sum Threshold and Identification (Sum TI) score and the extent to which their mood was aggregated with a partner (calculated using $r_{WG(j)}$ scores) was mediated by the subjective importance that olfaction has upon their lives (IOQ score). $R_{WG(j)}$ agreement scores were calculated for positive and negative emotional states for all dyads at each time point using a tool developed by Biemann et al. (2012). These $r_{WG(j)}$ agreement scores present an index of within-dyad agreement among

participant ratings of a single variable on multiple items (LeBreton et al., 2005). In this case, the agreement between a participants' assessment of their own emotional state with that of a dyad partner's assessment of their own emotional state. The individual participants were each nested into dyads alongside their known partner. The analysed multilevel structural equation mediation model took the level 1-1-2 format, therefore, the authors used an MPLUS (version 8.4) syntax outlined by Preacher et al. (2010). A maximum likelihood estimation method was used in order to adequately account for the non-normal distribution of the $r_{WG(j)}$ agreement scores for negative emotion (Lai, 2018). The syntax can be found in Appendix B.

The mediation model was first investigated in relation to Time 1 (arrival) and Time 2 (pre-task) for both positive and negative emotional agreement. The individually rated subjective measure of partner closeness was controlled for in these instances. These four models were each found to not meet the adequate model fit thresholds and the respective indirect $a \times b$ effects were non-significant.

The mediation model was run for the Time 3 (during-task) and Time 4 (post-task) time points after the pairs had had an opportunity to collaboratively complete the tasks and spend time with each other. A significant indirect effect would indicate that the relationship between olfactory threshold and identification scores with emotional aggregation values was mediated by individuals' importance of olfaction score. The dyads' performance on the preceding task and the dyad partner closeness ratings were controlled for in the multilevel mediation model, so that any impact on the pairs' emotional agreement did not occur as a result of the partners' relationship or their collaborative performance.

4.4 Results

4.4.1 Descriptive Statistics

Olfactory Sensitivity

The descriptive statistics for the olfactory function tests can be found in Table 4.1. The olfactory threshold and identification variables were summed to create a Sum Threshold Identification score (Sum TI score) for each participant, a technique similar to that used in previous research (e.g., Hummel et al., 2007). A Kolmogorov-Smirnov test indicated that the Sum TI scores were normally distributed ($D(70) = .077, p = .200$).

Perceived Importance of Olfaction

Mean values for the Importance of Olfaction questionnaire and each of the three subscales are listed in Table 4.1. The IOQ was found to have a Cronbach's alpha of .812.

Table 4.1

Descriptive Statistics for each of the Assessed Olfactory Measures

Olfactory Measure	Mean	SD
Olfactory Threshold Score	8.52	2.36
Odour Identification Score	12.07	1.84
Sum Threshold Identification Score	20.59	3.30
Importance of Olfaction (IOQ) Score	2.93	.38
Association Subscale ^a	3.14	.41
Application Subscale ^a	2.78	.50
Consequences Subscale ^a	2.85	.44

Note. $N = 70$

^a The three IOQ subscales are each listed here with the accompanying descriptive statistics.

4.4.2 Emotion Measures

The participants' mean positive and negative emotion values can be found in Table 4.2, along with the repeated measures ANOVA results comparing the group differences. Positive and negative emotional states were significantly different across the four time points. Post hoc tests using the Bonferroni correction indicated that the mean score for participants' positive emotional state at Time 3 was significantly higher than it was at Time 1, Time 2 and

Time 4. Post hoc Bonferroni tests for the negative emotional state ANOVA showed that the negative emotional state scores at Time 1 were significantly higher than at Time 2, Time 3 and Time 4.

Table 4.2

Descriptive Statistics and Differences Between the Experienced Positive and Negative Emotion at Time 1, Time 2, Time 3 and Time 4.

Emotion	Time 1		Time 2		Time 3		Time 4		Differences across Time
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Positive Emotion	2.94	.61	2.94	.63	3.31	.78	3.01	.82	$F = 18.94, p < .001$
Negative Emotion	1.35	.34	1.25	.28	1.17	.24	1.21	.28	$F = 9.53, p < .001$

Note. $N = 70$

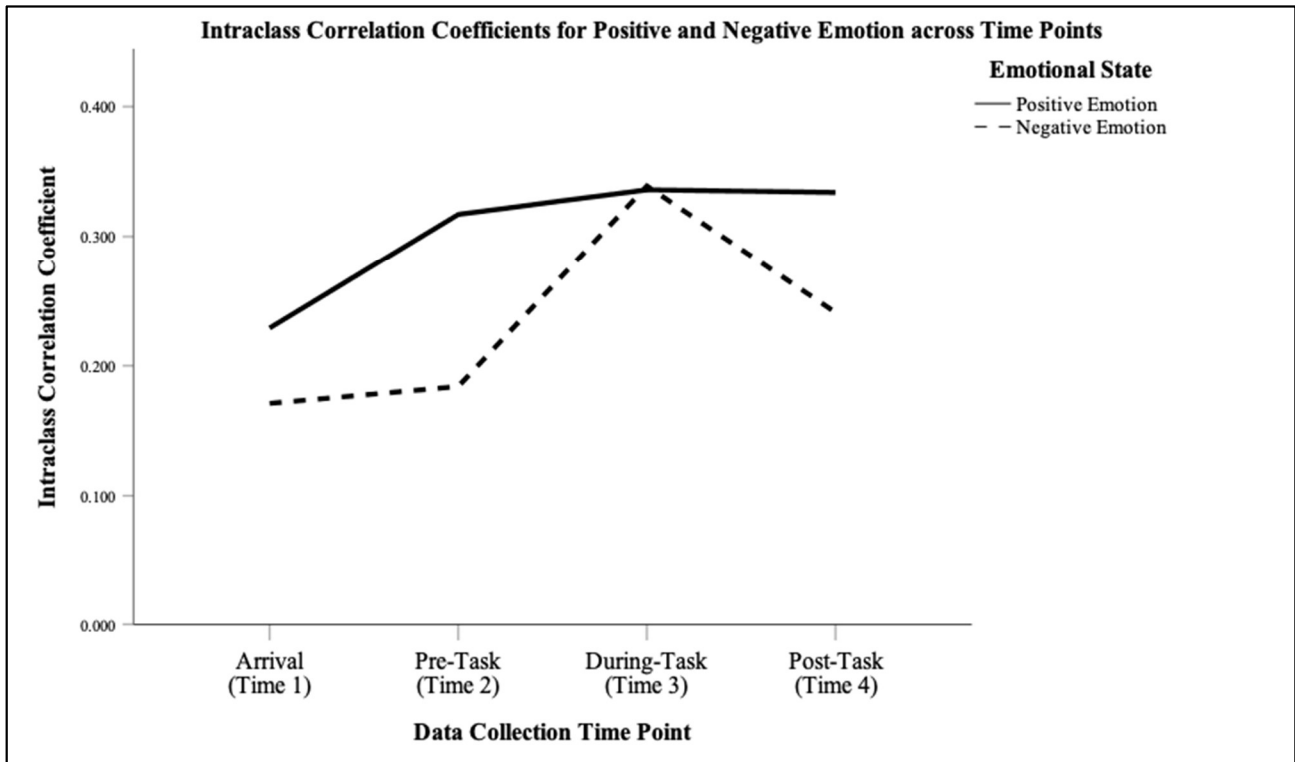
4.4.3 Emotion Agreement

The $r_{WG(j)}$ scores for negative emotions across all four time points were shown to significantly differ using a Greenhouse-Geisser correction repeated measures ANOVA ($F(2.47, 170.62) = 4.11, p = .01, \eta_p^2 = .06$). Following Bonferroni pairwise comparisons, it was found that negative emotion $r_{WG(j)}$ scores significantly increased from Time 1 ($M = .899, SD = .096$) to Time 3 ($M = .942, SD = .074$). There were no significant differences between the $r_{WG(j)}$ scores for positive emotion across the time points ($F(2.37, 163.53) = 1.03, p = .37, \eta_p^2 = .02$).

The participants' negative emotion ICC scores were found to be significant at Time 3 (ICC = .339, $p = .02$). In contrast, positive emotion ICC scores were significant at Time 2, 3 and 4, although the ICC score was marginally higher at Time 3 (Figure 4.1). These findings indicate that participants' within-dyad emotional states were distinct from the whole sample's emotional states at Time 3, for negative emotions, and at Time 2, 3, and 4, for positive emotions, therefore highlighting that within-dyad emotional aggregation had occurred at these time points.

Figure 4.1

A Graph Showing the Intraclass Correlation Coefficient Scores for Positive and Negative Emotional States across the Four Data Collection Time Points.



Note. Higher ICC scores indicate a higher within-dyad emotional association

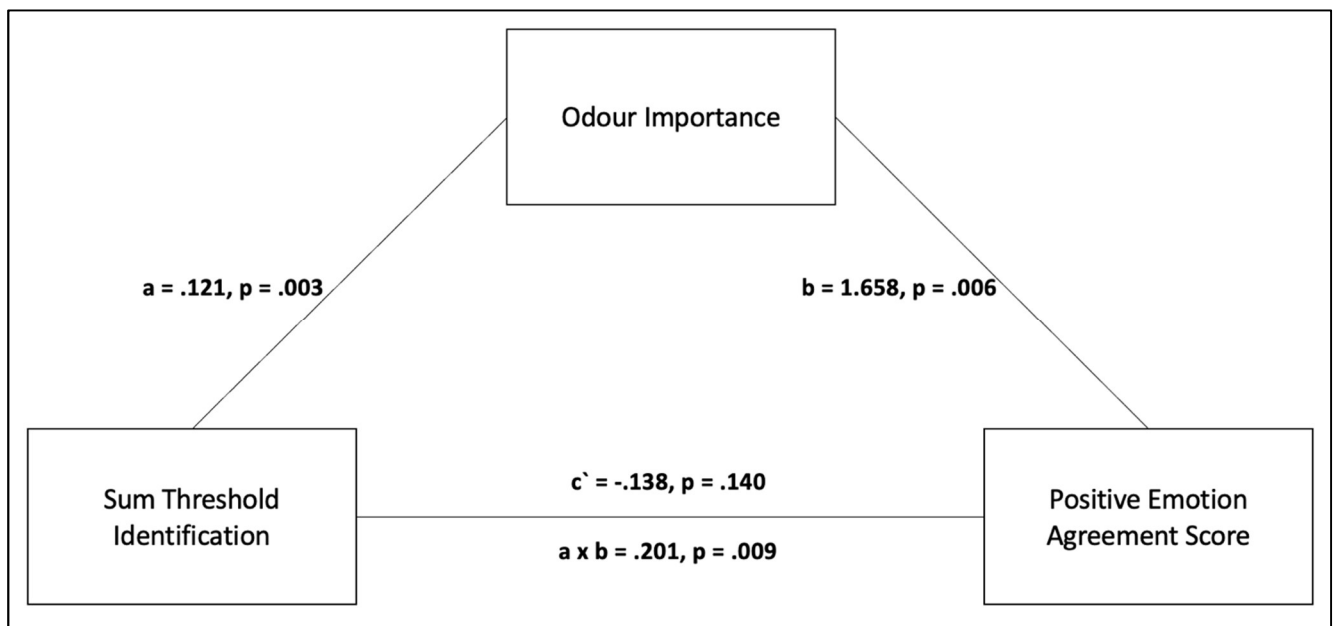
4.4.4 MSEM Mediation Model

The MSEM mediation model investigating positive emotional agreement at Time 3 (during task) presented adequate model fit ($\chi^2(3) = 4.03, p = .26, CFI = .93, TLI = .80, RMSEA = .07$). Sum TI significantly predicted individuals' IOQ scores ($B = .121, p = .003$) such that individuals with better olfactory functioning reported that they relied upon their sense of smell more in everyday life. In terms of the positive emotion agreement scores, it was found that these were not predicted by Sum TI score ($B = -.138, p = .140$), which was contradictory to the hypothesis. However, the emotion agreement scores were directly predicted by individuals' IOQ scores ($B = 1.658, p = .006$), which was also qualified by an indirect effect of Sum TI for positive emotion agreement via IOQ score ($a \times b B = .201, p = .009$). These findings suggest that the degree to which dyads' positive emotions aggregate is

predicted by IOQ but less so by Sum TI (Figure 4.2). The control variables, preceding task performance and partner closeness, did not significantly predict positive emotion agreement. The same MSEM model was found to be non-significant for both positive and negative emotion agreement scores at Time 4 and for negative emotion agreement scores at Time 3.

Figure 4.2

The Multi-level Structural Equation Modelling Mediation Model.



4.5 Discussion

In this study, the relationship between individuals' olfaction and their tendency to exhibit an aggregated emotional state to that of a collaborative partner was investigated. First, the participants were found to exhibit congruent within-dyad emotional states at three of the data collection time points, indicating that emotional aggregation had occurred. A significant relationship between the participants' attitudes towards the importance of their olfaction (IOQ) and their olfactory performance (olfactory threshold and olfactory identification) was also found. These findings are unique and provide the first evidence that normosmic individuals' wider olfactory function may be associated with their attitudes toward olfaction. Evidence for a direct relationship between importance of olfaction measures and olfactory

performance has previously been limited to one study (Landis, Giger et al., 2003). Yet Landis et al. did not use the Importance of Olfaction Questionnaire and only found evidence of a relationship between the importance of olfaction measure and odour identification. More recently, it was found that subjective attitudes toward olfaction (IOQ) were not related to objective odour function (Croy et al., 2011). However, in that study, IOQ measures were taken before odour function, whereas in the current study, the IOQ was completed after the olfactory tests. Relevant here is that previous work has identified that subjective assessments of olfactory ability can be positively associated with objective olfactory tests (Landis, Hummel et al., 2003), but only when the subjective estimation follows objective odour tests. To the authors knowledge, the present study is the first to report a positive association between IOQ and odour function in normosmic individuals and also supports the work on estimating olfactory ability (Landis, Hummel et al., 2003) and the importance of test order. Moreover, it extends our understanding by showing that beyond estimating olfactory ability, one's broader attitude on the importance of olfaction is related to odour function.

It was also shown that the role of olfaction in the aggregation of emotion showed that dyads' positive emotional agreement scores were associated with both the individuals' importance of olfaction score (IOQ) (directly) and their sum Threshold/Identification (TI) odour function score (indirectly via IOQ). The mediation model findings can be interpreted to suggest that the magnitude of emotional aggregation within dyads may be associated with individuals' odour function, which supports and extends the literature. Research has demonstrated that emotions can transfer between individuals by means of olfactory-detected chemosignals (e.g., de Groot et al., 2012). Nevertheless, whereas previous work has focused on the transfer of specific emotions (e.g., anxiety; Dalton et al., 2013; Prehn et al., 2006), the present data show evidence for the transfer of more global emotional states which encompass several emotions. This is important as these complex emotional states are experienced

frequently in social situations and their exhibition possesses unique social benefits, such as the building of interpersonal trust (Dunn & Schweitzer, 2005). The real-world utility of the findings is further highlighted through the ecologically valid methodology employed. The participant pairs completed collaborative tasks together in close proximity and the donor-receiver approaches often presented in the literature, and which require controlled explicit odour presentation techniques, were not utilised. The current findings therefore suggest that the singular intense emotion, sender-receiver methodologies used in previous studies (e.g., de Groot et al., 2015) may not be required to investigate olfactory-facilitated emotional transfer. The benefits of using a more ecologically valid approach are clear, in that any findings can be interpreted to show evidence of olfactory facilitated emotional contagion in a situational context mirroring a real-world scenario. Singh et al. (2018) showed that proximity to a socially relevant body odour was adequate to facilitate emotional contagion, and similarly, researchers have highlighted the role of olfaction and body odour detection in the natural formation of human social relationships (Mahmut & Cory, 2019). Thus, the current study has provided further evidence that olfactory assisted emotional communication can be implicitly facilitated and can occur in applied, real-world environments. Prominent researchers encourage the completion of more ecologically valid human body odour research (Roberts et al., 2020). Yet it is recognised that there are some costs present in trading a controlled odour donation and presentation methodology for the methods used in this study, which are grounded in greater ecological realism. For instance, odour signals were not manipulated or measured and therefore the role of body odour in the identified within-dyad emotional aggregation cannot be confirmed and an alternative factor may have affected the mediated relationship. Nevertheless, similar more naturally occurring methodologies have been utilised within the body odour literature (e.g., Frumin et al., 2015; Singh et al., 2018) and findings

from the current study indicate the involvement of olfactory mechanisms in the demonstrated emotional aggregation.

It was only at the third time point (during the collaboration tasks) that olfactory measures were found to influence the extent of emotional aggregation. There are two allied explanations for this, firstly, the Wii tennis task caused a significant change in positive emotion compared to the other time points and emotion intensity has been shown to be necessary in facilitating emotional contagion (Hatfield et al., 2014). Secondly, the Wii task involved more physical activity than the jigsaw puzzle task and more closely resembled tasks utilised in previously completed sweat odour donation studies (e.g., Mutic et al., 2015). Therefore, it is theorised that the active Wii Sports task caused the production of emotionally communicative chemosignals (Lubke & Pause, 2015), which influenced participants' emotional aggregation. This explanation would provide further evidence for the role of olfactory mechanisms in the emotional aggregation identified in this study.

In terms of odour function, it was surprising that there was a direct effect for the subjective measure of IOQ but not the objective measures of odour threshold and odour identification. Previous research has shown that odour threshold sensitivity is related to a number of emotional indices including disgust (Croy et al., 2017) and mood (Pollatos et al., 2007; Stafford & Wellbeck, 2011) and hence a stronger association may have been expected in the present study. Nevertheless, it is important to note that those studies found evidence for the so-called hot emotions (disgust, negative mood) relating to threshold sensitivity, which contrasts with the present study where effects were observed only in positive emotional states. Similarly, Croy et al. (2017) and Stafford and Wellbeck (2011) investigated participants' experienced emotions rather than their emotional aggregation, as was measured in the current study. It is therefore suggested that odour threshold and identification tests are less able to predict more complex social-emotional phenomena such as emotional

aggregation. In contrast, the IOQ focuses more directly on the social aspects of individuals' olfaction and is therefore more able to capture the social-odour link. For instance, some of the IOQ items¹ assess how an individual's sense of smell may impact upon their social interactions with others. This is also consistent with previous work which has found that individuals with higher IOQ scores tend to exhibit more socially conforming behaviours in social situations (Seo et al., 2013). Findings from the present study further indicate that the IOQ may better convey indications of an individual's social tendencies compared to objective TI measures. In addition, as has been suggested elsewhere (e.g., Smeets et al., 2008; Sorokowska et al., 2018), it could be that individuals who rate their sense of smell as important are also more aware of odours and consequently more sensitive to the positive and negative effects of odours. Extrapolating from this evidence, it can be theorised that individuals who score higher on the IOQ may rely more heavily on their sense of smell during social situations and therefore be more emotionally affected by others' positive and negative emotions. Hence, it is possible that such individuals are also more susceptible to emotional contagion. The findings from this study therefore highlight the first indication that subjective, socially relevant measures of olfaction, such as the IOQ, can be used to estimate an individual's tendency to exhibit an aggregated emotional state in social situations.

The investigated mediation model was not found to be significant during the transfer of negative affective states. This could be a result of the low instances of negative emotion experienced by participants in the current study. For instance, the participants' mean negative emotional state for the pre, during or post task time points did not exceed a score of 1.25 (using a Likert scale ranging from 0 *Not at all* – 5 *Extremely*). Previously it has been shown that the intensity of the experienced emotion is relevant in the interpersonal transfer of

¹ 'The smell of a person plays a role in the decision as to whether I like him/her' and 'If my partner has a nasty smell, I avoid kissing them'

emotions (Hatfield et al., 2014). Thus, it is considered that for the participants' experiences of negative emotion in the current study, this threshold was not met for specifically olfactory facilitated emotional contagion to occur.

In terms of limitations, it could be contended that the odour tests would have been better utilised if the threshold test used social rather than non-social odours. Nevertheless, it is noted that the tests used here are standardised olfactory tests, used extensively in research (e.g., Hummel et al., 2007). Additionally, whilst related work has utilised synthesised social odours such as androstadienone (e.g., Lundstrom et al., 2006), it needs to be recognised that developing a threshold test for 'naturally' occurring social odours, presents a number of technical challenges and would limit comparisons to future related work.

In conclusion, evidence has been presented here for the first time which indicates an association between Importance of Olfaction (IOQ) scores and normosmic individuals' odour function. Additionally, results from this study have shown that the importance that individuals assign to their sense of smell can predict their ability to experience an aggregate emotion. I posit that this relationship is caused by an increase in individuals' abilities to detect and respond to emotional chemosignals. Future research could further extend this work by continuing to examine the transfer of general affective states between individuals.

**Chapter 5: An Exploration of Within-Dyad Interpersonal Emotional Influence in the
Ambulance Service**

5.1 Abstract

Ambulance service personnel experience a wide array of emotions when working on shift.

Nevertheless, there has been a lack of research to date regarding the interpersonal effects that frontline staff members' emotional experiences and displays can have on their crewmates' behaviour and emotional state. This study used a critical realist research approach to explore the influential within-dyad effect of emotional exhibitions in frontline ambulance pairs.

Ambulance service personnel (N = 18) were recruited to take part in individual interviews and to complete post-shift voice diaries. Using abductive analysis methods, evidence for the Emotions as Social Information (EASI) Model processes, Affective Reactions and Inferential Processes, was presented through examples of self-reported interpersonal emotional transfer and emotional regulation. In addition, retroductive analysis of the interview and voice diary transcripts identified facilitative factors affecting the enaction of these social emotional processes. The dyadic relationship, individual differences in emotional concepts, organisational expectations, and the situational contexts of callouts were all themes which contributed to the tendency for Affective Reactions and Inferential Processes to occur. These findings provide support for the impact that EASI model concepts can have in performance domains and offer evidence to suggest how these socially influential processes may be contextually facilitated. The results presented in this study can be used by ambulance service trusts to better understand and improve the emotional relationships of their frontline dyads.

5.2 Introduction

The mental and physical demands of frontline ambulance service personnel are extreme (Brewis & Godfrey 2019). The role can be physically taxing, cognitively challenging and staff can be regularly exposed to traumatic events (Fernandez-Aedo et al., 2017). Nevertheless, shifts can also involve highly rewarding callouts which result in positive outcomes (Granter et al., 2019). The combination of each of these experiences can culminate in an intense and complex emotional environment, which ambulance staff must successfully navigate while striving to provide the highest quality care for their patients (Williams, 2012).

Working in partnership with ambulance service colleagues whilst on shift can help frontline staff to allay the challenges they experience in highly emotional scenarios (Lowery & Stokes, 2005). In the United Kingdom, ambulance service dyads will largely consist of a combination of paramedics and emergency care assistants. The performance of ambulance service staff has been shown to be impacted by the success of these dyad relationships (Travers, 2018), and the importance of teamwork and teammate familiarity has also been identified (Hughes et al., 2017). In addition, it is imperative that these ambulance service dyads partake in frequent intra-dyad communication in order to be successful (Patterson et al., 2017). Drewitz-Chesney (2019) explored the prevalence of emotional discussions in ambulance dyad relationships and found that the within-dyad communication can be identified as positive, negative and neutral by frontline staff. The emotional valence of the communication resulted in different outcomes for the individuals and the pair. For instance, positive interpersonal emotional discussions could reduce ambulance service teams' mental distress and improve wellbeing (Drewitz-Chesney, 2019). Ambulance service crewmates' emotional communication, coupled with a close dyadic bond (Filstad, 2010) and intense emotional experiences, indicate that these dyads may experience the social contextual characteristics required for interpersonal emotional processes. These socially influential,

interpersonal emotional concepts are outlined in the emotion literature (see the Emotions as Social Information model, Van Kleef, 2009).

The Emotions as Social Information model (EASI: Van Kleef, 2009) suggests that, in the same way personal emotions can provide information and influence our own behaviour, outward emotional expressions can also affect and inform other individuals. Individuals do not experience and express emotions in a vacuum, consequently, those in close proximity can observe others' emotional expressions and be influenced by them (Van Kleef, 2010). As such, Van Kleef highlights the role of social interactions and relationships in our emotional experiences. The EASI model presents two distinct processes through which an individual's emotional expressions can affect an observer (Van Kleef & Fischer, 2017). The first, Affective Reactions, refers to instances where emotional expressions can cause emotional responses in observers which can subsequently influence their behaviour. This process is evident in emotional contagion, defined as the conscious and unconscious interpersonal transfer of emotion (Hatfield et al., 1994). Similarly, these Affective Reactions can impact the formation of positive or negative social impressions. For example, observing expressions of happiness can often improve interpersonal impressions while observing anger can decrease liking and relationship satisfaction (Van Kleef, 2010). The second process by which emotions can cause interpersonal influence is through Inferential Processes. Observing and identifying another individual's emotional response to a situation can be useful in informing one's own emotional states or behaviour. For example, an individual's expression of sadness may cause observers to infer that the person has experienced an upsetting event and thus requires comfort or support, resulting in interpersonal emotional regulation. Van Kleef (2009) explained that the depth and nature of an observer's processing of a specific emotional expression may impact upon the likelihood of either Affective Reactions (shallow processing) or Inferential Processes (deeper processing) occurring. These differences will

subsequently change the observer's behavioural response. For example, emotional contagion can occur with an unconscious automaticity while individuals may choose to enact interpersonal emotional regulation if they see a colleague expressing sadness.

Evidence for the processes related to the EASI model has been presented across a range of performance domains such as sport (Friesen et al., 2013), business (Deng et al., 2020), the military (Wagstaff & Weston, 2014), and the service industry (Pugh, 2001). Similarly, interpersonal emotional concepts have also been identified within health care settings. Emotions have been shown to possess a social impact upon the decision making in oncology departments (Treffers & Putora, 2020), nursing practises (Moran, 2013) and the collective emotions that develop in hospital department teams (Petitta et al., 2017; Totterdell et al., 2013). Within the emergency services, police officers demonstrate EASI model emotional processes when they routinely use their own emotions to signal pertinent information to offenders and control or dominate emotional interactions (van Gelderen et al., 2011). Although their interactions with the public are often less hostile, ambulance service employees must also consider the effect of their own emotional displays during patient-clinician exchanges (Jennings, 2017). For example, a paramedic who expresses their anxiety towards treating a patient with severe injuries may cause their patient to feel distressed. Patient-clinician interactions highlight just one instance where the requirement is clear for ambulance service employees to understand both the deliberate and non-deliberate interpersonal effects of their emotions (Riley & Weiss, 2015). Indeed, frontline staff also experience and express a wide range of intense emotions in the presence of their crewmate throughout their shifts together. The complex relationships and extended periods of time that frontline ambulance service pairs spend together provide the opportunity for interpersonal emotional influence to occur (Clompus & Albarran, 2016), yet social emotional processes have not been explored within the ambulance service. Drewitz-Chesney (2019) outlined some

of the benefits that emotional discussions can elicit in paired paramedic teams, such as increased camaraderie and the development of interpersonal support. The impact of verbal emotional communication would indicate that ambulance service employees are adept at communicating and identifying social information. Nevertheless, emotional expression extends beyond verbal discussions and when working together for long shifts, other forms of emotional communication may socially influence and impact frontline staff. As a result, an investigation of the wide variety of emotional communication exhibited by ambulance service pairs would significantly advance the field in better understanding these social relationships.

In addition to a lack of research investigating evidence of social emotional processes in ambulance service dyads, the mechanisms which facilitate these processes in an emergency services context are also not currently clear. Factors affecting the propensity and processes by which an individual's emotions impact upon social interactions in general life have been outlined in the literature. In his introductory EASI model explanation, Van Kleef (2009) posited that the emotional social norms and the manner that the emotion is expressed are likely to influence an observer's behavioural response to expressions. Affective reactions such as emotional contagion have also been shown to be related to the intensity of the emotional expression (Hatfield et al., 2014), the degree of intimacy between the emotion sender and receiver (Kimura et al., 2008) and individual differences in emotional intelligence (Neves et al., 2018). Similar factors, including the strength of the relationship and the situational social norms, have also been shown to impact upon the susceptibility for interpersonal emotional regulation in performance domains (Tamminen & Crocker, 2013). Nonetheless, these facilitative factors have not been explored in the emergency services.

To address both of the gaps in the literature outlined above, the aims of this qualitative exploration were to identify instances of interpersonal emotional phenomena

facilitated through Affective Reactions and Inferential Processes, and subsequently to isolate factors and causal mechanisms that may impact upon occurrences of these concepts for ambulance crew dyads. This will be the first investigation of the EASI model processes in frontline ambulance service dyadic relationships. Evidence from similar domains would suggest that the social impacts of emotional displays in close-knit ambulance service teams will be far reaching and crewmates may interpersonally influence each other through emotional expression. In order to investigate the study aims, participants took part in interviews and completed post-shift voice diaries and a critical realist research approach was employed to analyse the data. This approach enabled a comprehensive examination of the data using both abductive and retroductive methods. Critical realism allows for a deep exploration of the phenomenon of focus and encourages the identification of underlying facilitative mechanisms which can explain the presence of these phenomena (Wiltshire, 2018).

5.3 Method

5.3.1 Research Design

This study was conducted from a critical realist philosophical stance. A critical realist approach refers to both positivism and constructivism in such a way that allows for the discovery of a truth which is not individually constructed, but that which is also not constant across all mechanisms and contexts (Ronkainen & Wiltshire, 2021). This philosophical position enabled me to explicate and identify, via interview transcripts, the fundamental social emotional concepts associated with the EASI model in ambulance service pairs, and subsequently to undertake retroduction to isolate the factors and mechanisms that influence the generation of these emotional phenomena (Fletcher, 2016; Ritz, 2020). By adopting this standpoint, I recognised the impact that the EASI model has in performance team relationships across multiple domains (see Friesen et al., 2020; Moran, 2013; Treffers &

Putora, 2020), yet I wished to discover the subjective interpretations that influence the contexts of this theory within specifically the ambulance service domain. In addition, a voice diary approach allowed for a corroborative method to explore the hypothetical theoretical structures and contributory mechanisms that were identified in the interview phase (Hu, 2018). Voice diaries were used as they have been shown to be an accessible technique for collecting in-depth qualitative data (Crozier & Cassell, 2016).

5.3.2 Participants

The participants were frontline ambulance service personnel recruited from three UK Ambulance Service Trusts. In total 18 participants were recruited ($n = 5$ female, $n = 13$ male). Sixteen of the participants were recruited as colleague pairs and completed both the interview and voice diary phases of research, two participants were recruited individually and took part in just the interview phase. Six of the pairs consisted of one qualified paramedic and one Emergency Care Assistant or equivalent rank, and two of the pairs comprised of two paramedics. The two individual participants were both paramedics. The sample included five male-male pairs, two male-female pairs and one female-female pair. The participants had worked for the ambulance service for between 1 and 20 years ($M = 5.9$ years, $SD = 4.9$ years).

5.3.3 Procedure

Each of the three Ambulance Service Trusts were approached for collaboration following both institutional ethical approval (SHFEC 2020-080) and NHS Health Research Authority approval (20/HRA/6255, see Appendix C). The participants voluntarily contacted the Principal Researcher if they wished to be recruited to the study with a crewmate. Details of the study were then sent by the Principal Researcher to the prospective participants and consent was sought.

The participants were asked to talk, in their voice diaries, about two events that occurred in the shift immediately prior to completing the voice diary. They were informed that their individual voice diaries must be recorded in private but should relate to the same two key events as their partner. First, the participants summarised the key details of two events, and then discussed their experiences of the emotional events. The participants were also instructed to discuss their assumptions and inferences with regard to their partner's experiences of the events. The paired participants agreed to complete their individual voice diaries following the next shift that they worked together, having given consent to participation in the study. Once these diaries were recorded, the audio files were sent to the Principal Researcher. The average length of the voice diaries was 9 minutes 55 seconds ($SD = 5m\ 45s$).

Following the voice diaries, the Principal Researcher arranged for each of the 16 paired participants to take part in semi-structured individual online interviews. The two non-paired participants also took part in these individual interviews. The interview questions focused on the main aims of the study and contained both primary questions and secondary probes. First, the participants were asked introductory questions regarding their experiences of their role in the ambulance service and their experiences of working in dyads. The second section focused on the emotions that the participants and their partners typically experience and their emotional expression tendencies while on shift. The participants were also asked to provide specific examples of emotion inducing callouts that they had recently attended and any instances when they had experienced unfamiliar emotions. The interview concluded with questions regarding the participants' general emotional expression outside of work. The efficacy and validity of the interview schedule was assessed prior to the study using expertise from the research departments at two of the participating Ambulance Service Trusts. Following these evaluative discussions, minor modifications were made to the interview

guide which included ensuring the ambulance service specific vocabulary and role descriptors were used in the correct manner and that the questions were suitable to elicit informative responses. The interviews lasted between 35 and 85 minutes ($M = 52$ minutes, $SD = 10$ minutes) and were each audio recorded in their entirety.

5.3.4 Data Analysis

The data were analysed in accordance with the critical realist philosophical stance. Specifically, Hu's (2018) analytical steps for critical realism research were utilised as a foundation for the method of analysis. The analysis used both abductive and retroductive methods in a complementary method of inquiry. Abductive analysis methods involve the integration of theory with observations, while retroduction is a method of uncovering the mechanisms fundamental to the development of a specific phenomenon (Meyer & Lunnay, 2013). These methods were utilised in collaboration as abduction can provide the preliminary work for the deployment of retroductive inferences (Eriksson & Engstrom, 2021, Ritz, 2020). First, the interview transcripts were analysed abductively using thematic analysis to identify the focal social events for this study. In this case, the focus was on interpersonal emotional phenomena associated with the Emotions as Social Information model (Van Kleef, 2009). Following this, retroductive thematic analysis was used to further the depth of the inquiry and establish causal structures and mechanisms which impacted upon the tenability of the EASI model processes in the social relationships of ambulance service pairs. Finally, the voice diary transcripts were analysed in a similar manner to the interview transcripts in order to corroborate the conclusions drawn from the abductive and retroductive methods previously completed. Instances of interpersonal emotional influence and evidence of causal mechanisms were identified in the voice diaries. All thematic analysis in this study was completed adhering to Braun and Clark's (2012) thematic analysis framework. This process began with reading and re-reading the interview and voice diary transcripts to become

familiarised with the data. Following the familiarisation process, excerpts of the data were coded with labels, which generated the initial codes. These codes were then clustered and grouped together into themes and thus higher order themes. These themes were continually reviewed and modified until they were finalised, and they were then defined and named in a succinct informative manner. All of the participant names have been replaced with pseudonyms throughout the analysis.

5.3.5 Research Quality

Ronkainen and Wiltshire (2021) outline three principles that can be used to assess and guide the validity considerations of a critical realist exploration. The first principle relates to utilising a focus on ontological plausibility. Ontological plausibility describes the act of using plausible theories as explanations and descriptions of real-world events (Harre, 2012). As a result, the validity of research is positively related to the extent to which the research is ontologically plausible. Empirical adequacy is a further guiding principle for a valid critical realist research study, which states that researchers must gather sufficient data. Techniques to achieve sufficient data collection may include using multiple methods, engaging with the focal research environment, and ensuring that the participants are suitable (Ronkainen & Wiltshire, 2021). Each of these criteria were achieved in the current study using multiple qualitative data collection methods (voice diaries and semi-structured interviews), extended collaboration and planning with the Ambulance Service Trusts and ensuring that participants were recruited from the target participant sample (ambulance crew members). The final principle is that of practical utility. Greater validity can be achieved when the findings of a study can be used to make changes and impact the world within the contexts investigated (Ronkainen & Wiltshire, 2021). The current research philosophy directly adopts this principle through the explanatory and causally relevant approach used to consider the EASI model processes (Archer, 1998). Identifying the mechanisms through which interpersonal emotional

influence occurs in ambulance service pairs can provide direct impact and utility for frontline ambulance service staff in navigating complex social issues.

5.4 Results

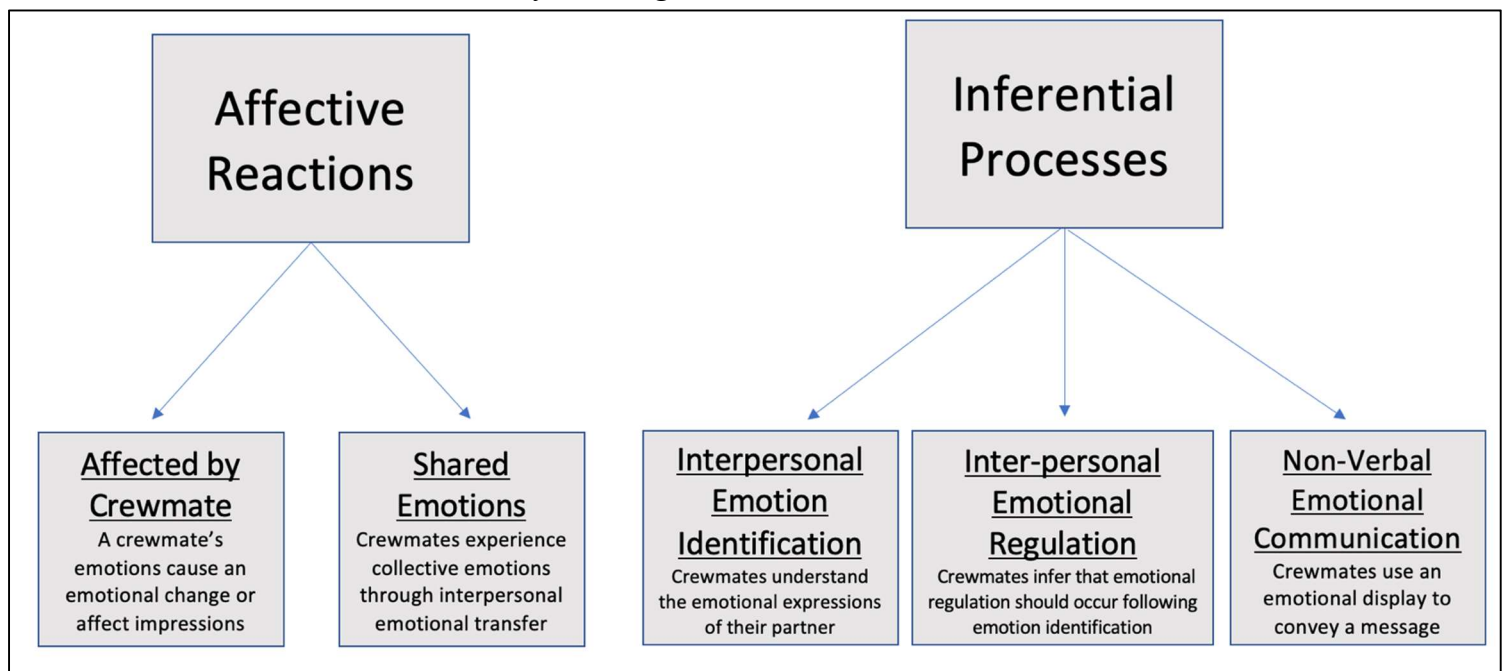
This results section is based on the analysis of both the participant interviews and voice diaries. All of the identified themes and subthemes can be found in Figure 5.1 and Figure 5.2.

5.4.1 Interpersonal Emotional Concepts

Evidence of affective displays eliciting an emotional change in crewmate observers (Affective Reactions) and behavioural change resulting from observer inferences (Inferential Processes) were presented in all 18 of the interviews conducted in this study and all 16 of the recorded voice diaries.

Figure 5.1

The Thematic Structure Identified Using Abductive Methods.



Affective Reactions

Two examples of affective reactions were identified within this data: affected by crewmate and shared emotions.

Affected by Crewmate. The frontline ambulance service staff outlined situations in which their emotional displays affected their crewmates' emotional states, and instances when they were emotionally affected by their crewmates' expressions. Darius described being affected by a crewmate's frustrated expressions on route to a job, "he was swearing all the way to the job and obviously that affected the emotions, so I was maybe not too happy with his attitudes on route". Petra also discussed an incident when a crewmate's emotional expression impacted upon her impression of her partner. She stated, "I was very angry I'm quite passionate about end of life, and actually that was disgusting her behaviour (...) if we show up with that attitude then it's just disgusting so that made it very difficult".

Evidence presented in the voice diaries also made it clear that crewmates could be emotionally affected by their partners' emotional expressions. The impact of an emotional display can be both positive or negative, and during one job a participant described feeling better after noticing that their partner displayed guilt after leaving them alone with a difficult patient and relative. Noah stated, "I now had both of them on my own...so even with a mask on, the look of guilt on his face when he returned made me at least smile".

Shared Emotion. Evidence was also presented which indicated that crewmates experience interpersonal emotional transfer. Instances of collective emotions and both conscious and unconscious emotional contagion were identified in these data. According to John, "if someone's being quite chirpy [a positive emotion], you can't help but be chirpy". This uncontrollable emotional transfer can lead to the development of collective emotions during the shift, as described by Harry, "I think we do share a lot of emotion, I think working as a crew on an ambulance is quite a unique dynamic situation because we are quite emotionally in tune most of the time". The frontline ambulance service employees indicated the existence of within-dyad shared emotions in a number of the recorded voice diaries. Megan explained that "both myself and George were nervous because the patient could have

a fit at any time again”, similarly Thomas described within-dyad collective frustration when trying to drive safely to a job “my crew mate was, whilst not driving, was of similar frustration and disbelief, anger at some of the people that we came across as we were attempting to make progress”. Additionally, one participant explained how their crewmate’s negative emotional displays can cause within-dyad emotional transfer and negatively affect the rest of the shift:

It affects me if I’ve come in with like a nice positive attitude happy and smiley and then I’ll see her there and she’s you know very short and not responding to what I’ve talked about. I’ll be like “Oh” [*participant slumps shoulders and exhibits an annoyed facial expression*] (. . .) I just think “oh this is gonna be a tough shift”. (Elizabeth)

Inferential Processes

Observers can draw inferences from an individual’s emotional expressions and these inferences may subsequently lead to a change in the observer’s behaviour. Three principal scenarios were found where inferential processes were present in the frontline ambulance service employee accounts: interpersonal emotion identification, interpersonal emotional regulation, and non-verbal emotional communication.

Interpersonal Emotional Identification. Gary succinctly summarised his approach to identifying his partner’s emotions by stating “it’s how they are, how they react to you and how you react to them”. These methods of identifying a crewmate’s emotions were demonstrated across the interviews and voice diaries by all of the frontline ambulance service staff. For instance, in John’s voice diary, he explained that he could see a situation was upsetting for his partner by “looking at his face and his demeanour”. Andy also mentioned that they could identify that their crewmate was anxious by “just the way he kind of put himself, you can sort of look into his eyes and see his mind was moving a million miles an hour”. A crewmate’s working behaviour is also used as an indicator of their emotional state. In David’s voice diary, he described how he had identified his crewmate’s heightened emotional state through their driving:

Gary would have been doing the advanced paramedic work, and also he was driving, so I think he would have been quite maybe not excited, but you know the adrenaline would have been going you know, we got there very quickly it was a very fast drive through town. (David)

As well as these examples of inferred interpersonal emotional identification, Ibrahim also explained that because crewmates “know you’re going to spend 10 hours with them, they normally tell you if they’re having a bit of a crappy day”. Consequently, the process of emotional identification can also occur simply through honest intra-dyad discussions.

Interpersonal Emotional Regulation. Interpersonal emotional regulation in this instance is an act to try to control and manage a crewmate’s emotional state. The participants recognised the importance of regulating their crewmates’ emotions, for instance one participants stated,

It wouldn't have been in anyone's benefit for me to say, yeah, you've cocked up there you know because he was quite a fragile chap anyway, so you have just kind of got to manipulate, not manipulate, you've got to manage his feelings, I guess. (David)

An example of this interpersonal emotional management was also described by Petra who explained that when her crewmate can “get a bit anxious” and starts “freaking out” she “[tries] to just bring him down and say doesn’t matter because we’re a team, we’re going to do it together”. The participants also described collectively regulating their shared within-dyad emotional state, such as trying to stay positive during long shifts:

Towards the end of the day you might be more sluggish and by that point you’re maybe both a little bit more tired. You just get to the end of the shift, you’re talking about the funny things that happened that morning, and then just try and keep the positivity going that way again. (Darius)

David also discussed, in his voice diary, collective interpersonal emotional regulation, a unique process in which crewmates collaboratively worked to improve the collective emotional state of their partnership. In this instance, dark humour was used to refocus the paired crewmates after a frustrating job:

I think at the end of the job we were both quite frustrated by the girls who called and the way the job had been described and I think there was a certain sense of release at the end of it where we both said incredibly dark things. (David)

Non-verbal Emotional Communication. The participants explained that they could indicate and communicate their emotions to their crewmates by non-verbal mechanisms. For instance, non-verbal emotional communication could be used deliberately by staff to convey an emotional message to their partner. For instance, Gary non-verbally explained to his partner that he couldn't cope with a patient's behaviour. Gary explained in his interview, "eye contact was made. It's just that little kind of, those tiny little body language movements which are like yeah, "I'll be off now" and yeah, he knew that I couldn't cope with it".

Similarly, Charlie explained that eye contact was used during an event discussed in their voice diary to indicate support for their partner when a patient had become domineering. Another participant explained that taking a patient's pulse for an extended period of time was used by their crew "as an indicator for each other of, like, help", so that their partner could offer procedural or emotional support. Alternatively, non-verbal emotional communication can be just as emotionally communicative when spontaneous in nature and less controlled. For example, one participant explained:

I've had a choking child before and you get there and the child is crying [which indicates that the child is breathing] and both of you just look, I mean there are no hugs and kisses or anything else, but you just look at one another and it's like oh thank God for that. (Noah)

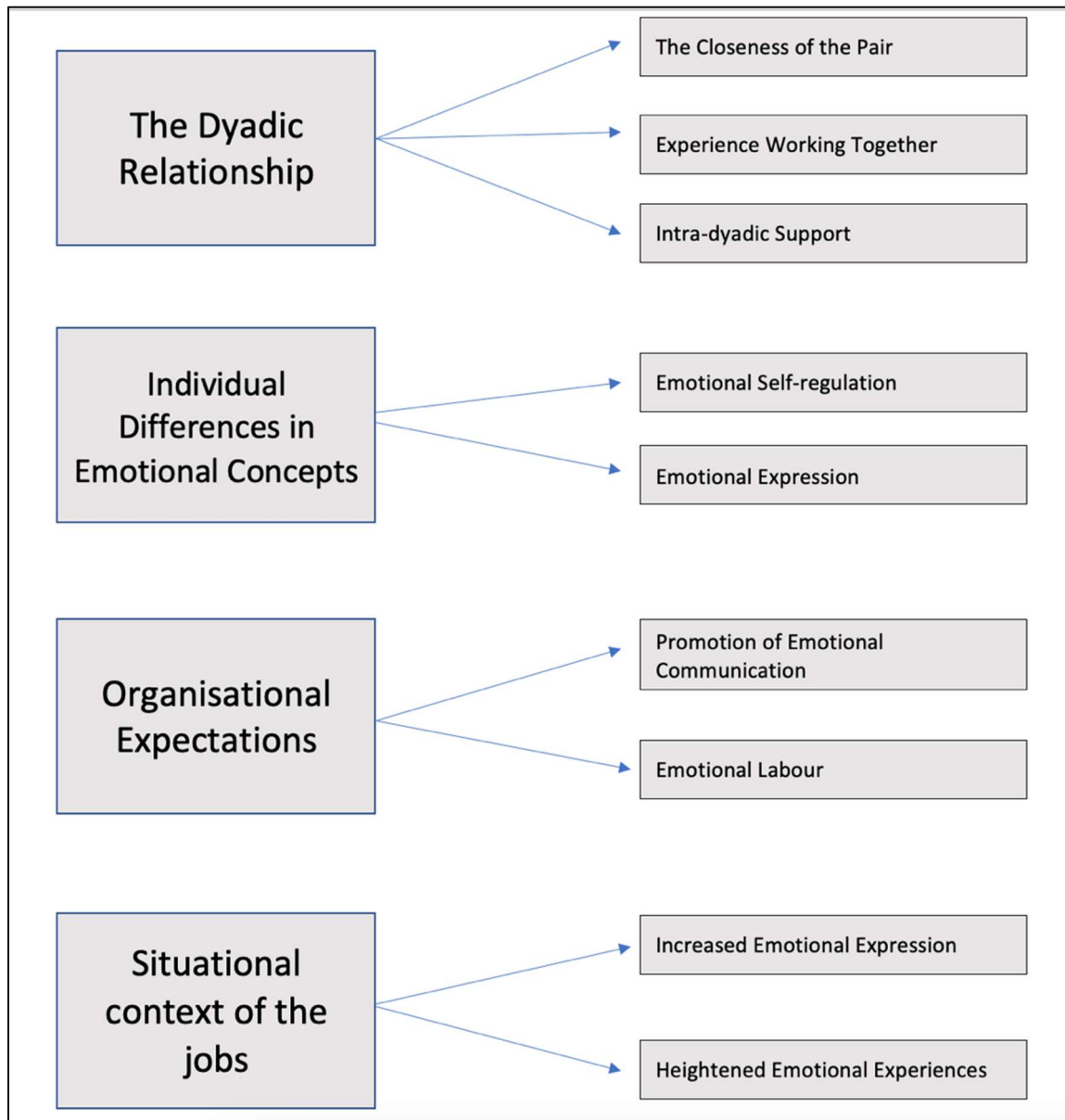
Here, the crewmates were able to communicate their relief to each other quickly through non-verbal mechanisms.

5.4.2 Mechanisms Affecting the Interpersonal Emotional Concepts

I used specifically retroductive methods to uncover the underlying facilitative mechanisms for the interpersonal emotional processes described above. Four themes were identified which each included secondary themes that further explained how EASI model processes emerged in these crewmate pairs.

Figure 5.2

The Thematic Structure Identified Using Retroductive Methods.



The Dyadic Relationship

The data showed that the relationship that the crewmates shared was integral in determining whether the pair would experience interpersonal emotional influence processes.

The Closeness of the Pair. The ambulance service employees discussed that they experienced stronger attachments with some crewmates compared to others, Andy stated “we just click, you click with some you don’t with others”. These relationship differences were shown to impact upon the likelihood and the type of interpersonal emotional concepts that

were experienced by the crewmates. Andy also described that the strength of his relationship with his partner meant that they were better able to identify each other's emotional states. He explained, "I'm very good at reading Harry in that instance, because as I say I'm quite close to him, I know when he's having a good day or when he's having a bad day".

As well as the interpersonal identification of emotion, the participants also described being more likely to explicitly share their emotions with a crewmate for whom they felt close. For instance, Hannah explained in her voice diary that she was "very good at reflecting and debriefing" with her crewmate because of their "strong partnership", and Oliver explained that "if it's somebody you don't like or don't trust particularly, you're not going to start, you know, spilling out your heart about everything". Similarly, Noah stated that they would be "more outgoing" when working with Darius because of the "good partnership" they shared. It is likely that these more authentic emotional displays can encourage more interpersonal emotional influence through the EASI model processes.

Experience Working Together. As well as the pair closeness, the experience that the pair had working together also affected their likelihood of experiencing interpersonal emotional influence. This experience was affected by both the time spent working together and the fact the crewmates could be "bonded" after attending "proper jobs" together. These "proper jobs" often involved patients with more life-threatening illness or injury such as cardiac arrests or road traffic collisions. The participants also described a better emotional understanding when they had worked with their partner for a long period of time. For example, Harry described that "particularly people who work together long term, so Andy and I, is that we think on a similar wavelength". In addition, the interpersonal emotion identification and communication is often improved for crewmates following an extended number of shifts together. Abdul explained "if I've got five days with him, on the third day [if] I'm really cranky for some reason, he picks up on it quite quickly". George also used his

experience working with his crewmate to identify that they were calm and not panicking at the scene of the incident:

It's because we've worked together for the best part of a year, we know each other's character, we know how each other work, we can probably pick up subconsciously on like signs from each other as to when somebody thinks something's wrong [or] not wrong and you know when we're panicking and when we're not panicking. (George)

As well as an improved emotional identification, an extended period of working together can also facilitate an interpersonal emotional transfer. Megan explained, while working with an especially “calm” and “level-headed” crewmate, that “this is my third week in rotation [with the crewmate], so I'm sort of in my chill stage now”.

Intra-dyadic Support. The support that both members of the crew provide for each other was highlighted as a key theme which affected interpersonal emotion. George outlined how an “instilled mentality” to support a crewmate often resulted in interpersonal emotional regulation and participants taking steps to control and manage an emotional situation for their crewmate. For example, John explained that he felt a responsibility to support his crewmates and interpersonally manage any distress that they were experiencing during the job:

If I look at somebody and they're not really coping with it and they look a bit distracted or whatever, I'd be like if you want to feel free to go and sit in the truck (. . .). Yeah generally I'll ask them to step outside so I can then deal with whatever's going on and then have a chat afterwards and sort of see what the issue is then. (John)

Other participants reported experiencing similar regulation of their emotions from the intra-dyad support that their partner provided. Crewmates were generally able to identify emotional distress in their partners and attempted to control that distress by managing the situation for their crewmate. For instance, Thomas described an event where his partner tried to stop him from experiencing more distress as a result of attending a very difficult callout:

You know he is good at reading me and he has, you know, we went to what was a pretty well confirmed hanging sort of thing and he was like, “I can leave you, you don't have to come up” to protect me from it. (Thomas)

Individual Differences in Emotional Concepts

The participants explained that significant differences exist in the tendency for frontline ambulance service employees to express and regulate their own emotions. These differences can be identified by others and can impact upon the within-dyad authentic emotional communication and the demonstrated EASI model emotional processes.

Emotional Self-regulation. Ambulance service personnel differ in their tendency to demonstrate emotional self-regulation and the techniques that they use. Abdul explained “we all manage situations differently but a part of that is managing your own stresses”. A number of the participants described talking out loud as a method of controlling pre-job anxiety and reducing stresses, although they worried that this method may have interpersonal consequences. For instance, Petra explained that when approaching a “worrying” job she will talk through her thoughts while her partner will often want to “sit quietly” and that this difference in approach “probably does annoy” her crewmate. Conversely, George described an instance when “going through all these scenarios in my head and out loud” led his partner to stop him and attempt to calm him down by encouraging a rational psychological approach to the anxieties attributed to the job.

Some of the participants discussed emotional self-regulation methods which may reduce instances of interpersonal emotional influence. For example, Andy explained that following a stressful job he would “just take a walk and sort of don't really tend to talk to anybody about it and so I'll just clear my head that way”. Nevertheless, Andy also mentioned that his relationship with his regular crewmate was so strong that if he “walked away then yeah, [his crewmate] would know there's something up”. This indicates that emotional suppression may not negatively impact the interpersonal emotional influence experienced in specifically close crewmate partnerships.

Emotional Expression. The individual emotional expression tendencies of ambulance personnel were also shown to impact upon affective reactions and inferential

processes. Darius explained that some of his colleagues were more emotionally expressive and could be “a natural exuder of positivity”. Darius also stated that when working with these more expressive and positive individuals he will often “feed off of that and have a more jokey, I’ll say more of a fun day”. In addition, the degree to which a crewmate expresses their emotion can also affect the emotional intensity expressed by their partner. For example, Oliver explained that more generally “talkative” crewmates and crewmates who were not “reserved” help to facilitate more in-depth debriefs and emotional discussions following jobs. Similarly, Abdul discussed attending a job which was especially personally emotional, but he decided not to be open and share his emotions with his partner because the crewmate was known for his lack of emotional expression:

I didn't actually speak to anyone about it and I never have because you gauge it on your crew mate at the time (. . .) He's just not an outwardly emotional chap, he's more of a traditional no emotions bloke. He’s not one of those sorts of people that I think I've ever, I think I’ve maybe have had a heart to heart with him once but in the eight years that I've known him. (Abdul)

Decisions to not explicitly share emotions with crewmates, affect the interpersonal influence that the ambulance service staff’s emotions can have on their partner and can limit instances of collective emotion.

Nevertheless, participants also discussed scenarios where they understood their partners to be uncontrollably expressing their emotions, which suggests that even those ambulance service staff who consider themselves emotionally inexpressive may still emotionally influence their partner. Hannah described this in her account of her crewmate’s emotional expressions:

She’ll sort of like slam the doors or she’ll drop her bags down like really heavy, I sometimes just see her like tutting or like shaking her head, I don’t know if she thinks that it's like not something that's like visible or I don't know. (Hannah)

Organisational Expectations

The participants described expectations placed upon them by the wider organisation and the job role itself as impacting upon their tendency to collectively express and experience interpersonal emotional states.

Promotion of Emotional Communication. The ambulance service personnel explained that their Trusts had made a conscious shift towards encouraging staff to undertake more open emotional communication. Yolanda explained that “being in the service for nearly 11 years I have seen a progression of people talking more openly compared to when I first started, it’s definitely improving for sure”. Other participants described this opportunity for crewmates to discuss distressing emotions with their peers:

I've had a bit of an issue on that job can I have a chat? It's for that side of the environment [the job] it's fantastic to know that we've got that support from colleagues, management, all the way up to senior management (Charlie)

Oliver further explained how the organisational culture helped to ensure an “ambulance mentality instilled in us from students all the way into practice, of reflection and sharing” which leads to emotional discussions becoming “standard practice” for ambulance staff.

An increased emotional communication and expression can help in promoting further within-dyad emotional understanding, as well as interpersonal emotional regulation and transfer. Further emotional displays are more likely to lead to ambulance service crewmates experiencing the emotional influence outline in the EASI model.

Emotional Labour. Although honest emotional expression is encouraged by Ambulance Service Trusts, there are still expectations placed on frontline personnel that this emotional expression should not impact upon patient care. As a result, emotional labour and emotional suppression are experienced by many frontline staff in the presence of patients and, in some cases, colleagues. Abdul explained that in their training for the role, they were taught that when they are with a patient it “is not your time to cry”. In addition, Hannah stated that “even if I wasn't feeling my best, I always do my absolute best to leave it in the ambulance

because it's not fair on patients to ever sort of experience our mixed emotions". It is possible that this emotional suppression may impact upon the within-dyad emotional influence, however, evidence has been presented outlining crewmates' coded emotional communication in the presence of patients and the aptitude that crewmates have for identifying even their partners' shielded emotions. In Darius's voice diary he discussed suppressing emotion around patients, whilst still emotionally communicating with his partner:

I would never actually show this level of irateness [*sic*] to a patient, relative, friend or family um and so consequently I did glance at my crewmate and we've actually worked together a fair bit before so we sort of know how each other works. (Darius)

Additionally, the suppression of emotional expression while working with patients was also shown to lead to increased outbursts of subsequent emotion when solely in the presence of a crewmate. For instance, Andy discussed an upsetting job where the pair "found it very difficult to sort of hide [their] emotion" from the patient. Following the completion of that job, Andy stated that:

I had a bit of a chat with my crew mate, she got quite emotional, and you know, I sort of gave her a hug and said look and we just talked about it and that we'd done the best we can for him and yeah, that was really quite emotional. (Andy)

A delayed heightened release of emotion following emotional suppression can also be aimed at a crewmate. Elizabeth mentioned a disagreement that she had with her crewmate, although in a "high pressure situation you do everything first and then you think about it later and then that's when it kind of like, the frustration comes out". Therefore, it is likely that although emotional labour may, at times, impact the within-dyad emotional influence in the presence of patients, it is unlikely that this will have a lasting impact on the intra-dyad emotional communication and influential emotional processes.

Situational Contexts of Callouts

Frontline ambulance personnel attend a wide range of callouts during each shift which vary in the level of emergency and the nature of the job. These different callouts can impact

the EASI model interpersonal emotional influence experienced by the crewmate pairs because of the differing levels of emotional experiences and expression.

Heightened Emotional Experiences. The participants described how callouts which are more emotionally challenging or rewarding will often lead to a greater experience of emotion. For instance, Andy explained that “especially when it comes to paediatrics, myself and a lot of other clinicians get quite anxious when it comes to children”. Some jobs may be more emotionally difficult for only one member of the crew and the participants discussed being able to identify these jobs and respond appropriately to their crewmates’ emotions. John explained in his voice diary that he felt “due to sort of recent events, without going into too much detail, Ibrahim was probably a little bit more affected by it so to speak, in terms of it's quite a sad situation to see him be in”. In some cases, distressing shifts can create collective within-dyad emotional states which can be difficult to emotionally manage. Petra described attending a difficult job with her crewmate which took “a good couple of hours just to get it out of our system and be able to sort of go on to the next job”. Nevertheless, Ibrahim explained that these collective emotions in stressful times can also help in developing the interpersonal emotional support that the crewmates receive as they are both aware of the emotional situation.

When you do more stressful shifts it does make you a little bit more on edge but then as crewmates, you're always aware of that because you know you're working the same shift and you know you're always gonna be tired by the end of it and so I think you're all just supportive of each other. (Ibrahim)

Increased Emotional Expression. The participants explained that when attending emotionally intense jobs, they often demonstrated increased emotional expression and found it harder to suppress and mask their authentic emotional states. For example, Abdul stated “if it's a sad situation, and it's an elderly couple been married 60 years and one of them is dying I might struggle to contain my kind of visible emotions there”. Similarly, Andy explained that often he will use “high intensity” jobs such as “cardiac arrest jobs” as a benchmark for

understanding an unfamiliar crewmate's emotional state, because "the manner they speak to [him] or they direct [him] to do something" will be emotionally informative. In these instances, because of the high-pressure situation, the crewmate's emotional expression is often less controlled and more candid in exhibition. The propensity for increased expression at some jobs was also demonstrated in Hannah's voice diary, where she explained that she was feeling "very anxious" on the job as it was the first time that she had made a decision regarding a Do Not Resuscitate order (DNR). Hannah suspected that her crewmate could identify this heightened anxiety, she said, "I think Elizabeth knew that I was worried I was probably a bit flappy". Increased emotional expression can also occur as a result of positive jobs and can further advance collective positive emotions:

You're at a high absolutely, and with Charlie he talks just as much as I do so no one really gets a word in just to the "and then we did this, and then this happened", it was great you know, and you just talk like that all day and then yeah it does it does lift you. (Petra)

5.5 Discussion

The aims of this study were to investigate instances of interpersonal emotional influence in ambulance service dyadic relationships, as outlined in the Emotions as Social Information model (EASI: Van Kleef, 2009), and to identify contributory mechanisms for the development of these influential social emotional processes. Both voice diaries and semi-structured interviews were used to explore the common emotional behaviours of frontline ambulance service staff whilst working on shifts with their partners. These behaviours included the frontline staff's experienced emotions and their emotional displays. It was found that the ambulance service pairs self-reported within-dyad emotional influence through both Affective Reactions and Inferential Processes. These processes were affected by causal mechanisms which included the dyadic relationship, individual differences in emotional concepts, organisational expectations, and the situational contexts of callouts.

The primary finding from this study related to the identification of instances of interpersonal emotional influence in frontline ambulance service partnerships. The participants first described events in which they or their partners demonstrated Affective Reactions, the process of an individual's emotional displays causing emotional responses in observers. Similarly, evidence of Inferential Processes, observers changing their behaviour based on an individual's expression of emotion, was identified. These two methods of interpersonal emotional influence are outlined in the EASI Model (Van Kleef, 2009). The findings are therefore consistent with the EASI model and suggest that emotional influence is present in ambulance service dyad relationships. This follows previous identification of EASI processes in social work (Gausel, 2011), large nursing teams (Moran, 2013) and offender/police interactions (van Gelderen et al., 2011), although, not up until now, in collaborative emergency service teams.

Instances of emotional influence through Affective Reactions included the ambulance service staff being emotionally affected by their crewmates' emotional displays and the experience of positive and negative collective emotions facilitated by emotional contagion. The process of emotional contagion has been identified across a range of performance domains such as sport (Totterdell, 2000), organisational contexts (Johnson, 2008) and in healthcare teams (Bakker et al., 2005). Nevertheless, this is the first identification of emotional contagion in emergency services dyads and highlights the role that emotional displays can play in directly affecting the emotional states of work colleagues.

Also evidenced were Inferential Processes affecting observers' behavioural changes in response to colleagues' emotional expressions. First, the participants demonstrated an aptitude for identifying their crewmates' emotional states through their emotional displays. The ability to identify others' emotions easily and quickly is a cornerstone of the EASI model (Van Kleef, 2010) and allows, in this instance, for ambulance service personnel to influence

and be influenced by their partners' emotional expressions. The participants also described being able to deliberately convey their emotions non-verbally to their crewmates, which further highlights the capability that crewmates possess in influencing their partners through emotional displays. This non-verbal emotional communication was facilitated through eye contact, facial expressions and behavioural codes. A previous interview study by Drewitz-Chesney (2016) showed that ambulance service pairs may verbally communicate their emotions to each other through open discussions. Nevertheless, the current exploration extends these findings and presents the first acknowledgement that ambulance crewmates can also identify their partners' deliberate and accidental *non-verbal* emotional expressions too. A further emotional inferential process that the participants demonstrated was the use of interpersonal emotional regulation. Interpersonal emotional regulation is the act of deliberately managing another's emotional state (Zaki & Williams, 2013). For example, in this study, ambulance service employees discussed trying to calm crewmates who were exhibiting anxious behaviour on route to a callout. Additionally, the frontline staff explained that they enacted collective interpersonal emotional regulation in collaboration with their crewmate. Unlike interpersonal emotional regulation, in which an individual looks to regulate the emotions of another individual (see Tamminen & Crocker, 2013), collective interpersonal emotional regulation presented an unspoken process during which the dyad members aimed to mutually improve the pair's shared emotional state. For example, instances of collective interpersonal emotional regulation occurred at times such as when both crewmates were exhausted and feeling negative during a long shift. Despite evidence of interpersonal emotional regulation in related domains such as health care workers (Martinez-Inigo et al., 2013) and prison workers (Niven et al., 2007), this is the first identification of collective interpersonal emotional regulation in any organisational context and represents an interesting avenue for future research.

Using retroductive analysis methods, four overarching mechanisms were identified which facilitated the EASI model processes in the context of ambulance service pair relationships. These causal factors included the dyadic relationship, individual differences in emotional concepts, organisational expectations and the situational contexts of callouts. Previous studies have also identified the impact that the social relationship can have on encouraging emotionally influential social processes related to EASI model concepts. For instance, Tamminen and Crocker (2013) found that the length of time that a sports team had spent together impacted on the comfort with which teammates demonstrated interpersonal emotional regulation. Similarly, Drewitz-Chesney (2016) found that verbal expressions of emotion, which, owing to the current study, can now be recognised as leading to interpersonal influence, were more common for paramedic teams that had spent more time together and that trusted each other compared to those who had spent little time together. The results showed that good dyadic relationships not only encouraged emotional expression, but also meant that crewmates were more adept at identifying crewmate emotion, more likely to experience emotional contagion, and more likely to undertake interpersonal emotional regulation. Provided that the interpersonal emotional influence is positive, these findings indicate that it is important that specific crewmates are regularly crewed together and that the within-dyad relationship is amicable. Additionally, these results suggest that the initial allocation of crewmates in the ambulance service may require a systematic process related to staff members' personality and interests, rather than a random allocation.

In this study it was also found that individual differences in both the emotional expression tendencies and the emotional regulation techniques of the ambulance service personnel impacted the susceptibility for crewmates to experience interpersonal emotional influence. Other personality characteristics and constructs such as an individual's affective presence (Eisenkraft & Elfenbein, 2010) have been shown to affect interpersonal emotional

concepts (Madrid et al., 2016). These findings therefore support the theory that there are individual differences that can facilitate or impede instances of social emotional influence.

In addition, the organisational expectations placed upon frontline ambulance service employees were found to act as facilitators for the EASI model interpersonal emotional processes. There has been a marked change within the ambulance service in recent years towards the promotion of emotional expression and open communication within crewmate pairs and wider workplace relationships (Association of Ambulance Chief Executives, 2018). As a result, ambulance service employees are more aware of their crewmates' frequent emotions in specific situations and they can therefore identify, influence and be influenced by these emotional displays. Other researchers have highlighted this cultural change within the ambulance service (Clark et al., 2021), and honest emotional communication is expected to continue to improve (Quaile, 2016). The participants in the current study described an expectation that patient facing staff demonstrate emotional control and suppression when working with patients. Interestingly, instead of this reducing interpersonal emotional influence, crewmates were found to still influence their partners in the presence of patients through coded emotional communication and uncontrollable emotional displays. Periods of emotional suppression towards patients were also found to lead to outbursts of emotional expression when crewmates were later alone with each other, which subsequently facilitated further interpersonal Affective Reactions and Inferential Processes. These findings therefore advance the literature and can be interpreted to suggest that although relevant in the patient/clinician relationship (Brighton et al., 2019; Williams, 2013), emotional labour does not reduce within-dyad interpersonal emotional processes in ambulance crewmate relationships. Emotional labour can, in fact, specifically enable within-dyad emotional influence in some instances.

This study is the first to explore the socially influential emotional processes described in the Emotions as Social Information model (Van Kleef, 2009) using a critical realist approach. Although the critical realist philosophy is criticised at times for methodological inconsistency (Jefferies, 2011), the approach helped to successfully identify instances of interpersonal emotional processes and consider factors that may facilitate these processes within the context of interest. Critical realists do not proclaim to uncover universal truths related to the focal theory (Cruickshank, 2012), and as such it is recognised that the findings presented here are relevant to the experiences of frontline ambulance service personnel. Nevertheless, it is maintained that the findings have relevance to emotion work in other organisational settings. One of the strengths of this analytical approach was the use of both abductive and retroductive methods when assessing the participant transcripts, as a result of the complementary nature of these processes (see Ritz, 2020). Despite the benefits, this approach is a unique methodology in this performance domain context, and therefore other researchers should be encouraged to further use these qualitative analyses.

A strength of critical realism is that it lends itself to a mixed-methods approach and both qualitative and quantitative data collection methods can be adopted (Zachariadis et al., 2013). Although in this study the post-shift voice diaries offered useful qualitative data, the data collection method may have been improved by also including quantitative emotion measurements in these diaries. Nevertheless, real time assessment of emotion during emotionally intense callouts would not have been possible owing to the time-sensitive nature of the work, and researchers would not have been able to supervise the collection of this data. Instead, the combination of the voice diaries and semi-structured interviews provided rich qualitative data. With the recent introduction of brief emotional measures suitable for use in performance domains (see Freemantle et al., 2021), future studies may be able to utilise a

quantitative facet to any mixed method designs to further investigate emotional relationships in applied domains.

This study was completed in collaboration with three UK ambulance service trusts and as a result, the applications of these findings are vitally important. It has been established that the emotions and expressions of frontline ambulance staff can influence their crewmates in a variety of ways including leading to shared emotional states and encouraging interpersonal emotional regulation. It is important that individuals in trust management positions recognise the role that emotional states can play in the crewmate relationship and inform their frontline staff of the impact of their own emotional expressions. Additionally, by referring to the four identified influencing factors, ambulance service employees may also acknowledge individuals, pairs and situations where interpersonal emotional influence will be most pronounced and prepare for these impacts.

Chapter 6: General Discussion

6.0 General Discussion

To date, researchers have yet to investigate the influential interpersonal effect of emotional expressions in performance dyad relationships. In sport, evidence has been presented to suggest that emotions can be interpersonally transferred between members of large sports teams (Rumbold et al., 2021; Totterdell, 2000). Further, other socially influential processes, for example interpersonal emotional regulation, may be triggered by emotional displays during sport (Friesen et al., 2015; Moll et al., 2011; Tamminen et al., 2019). Yet, these investigations have not directly considered the dyadic sport relationship. Accordingly, an aim of the current thesis was to examine whether emotional transfer and subsequent convergence was present in collaborating doubles table tennis pairs. To investigate the emotional contagion process during doubles matches, it was necessary to develop and validate a new, brief, in-competition emotion questionnaire which could be used in this context.

A further aim of the research programme was to investigate instances of interpersonal emotional influence, in line with the Emotions as Social Information model, in the context of frontline ambulance service pairs. No previous research has explored the EASI model concepts in this domain and therefore the present investigation was unique in this regard.

The final aim of this thesis was to identify salient factors (such as contextual, social and psychophysiological elements) that impact upon interpersonal influential processes in performing dyad relationships. These factors were investigated specifically in frontline ambulance pairs and in dyads collaboratively completing tasks in a laboratory study.

The objective of this chapter is to outline and summarise the key research findings from this thesis and to describe their theoretical implications. The strengths and limitations of the research will also be discussed and the practical applications in relation to the two key performance domains will be explained.

6.1 Summary of the Findings

A key aim of this research programme was to discover whether dyadic partners competing in sport matches experienced within-dyad emotional aggregation and convergence. To achieve this, the athletes' emotions needed to be assessed quickly and easily at in-competition time points. Yet, prior to this programme of research, no suitable in-competition sport specific emotion questionnaire existed. As a result, the first stage of this research programme (Chapter 2) concentrated on developing and validating a brief, in-competition emotion questionnaire relevant for use in sport. This development process began by utilising an item list curated in the early stages of the development of the Sport Emotion Questionnaire (SEQ: Jones et al., 2005). The SEQ specifically focused on pre-competition emotion in the latter stages of the development process although the initial item list was relevant to the emotions experienced at all stages of sport competition. This list of items was then reduced using two stages of expert analysis and large-scale athlete face validity. The reduction process led to the development of the ten item Brief In-Competition Emotion scale (BICE: Freemantle et al., 2021). The initial validation process assessed the scale's convergent and criterion validity using pre-existing questionnaires, and the BICE scale was found to perform well in these validity assessments. In sum, a brief, sport specific emotion questionnaire was created which could be administered quickly during sport competition to assess athletes' emotions.

The development of the BICE scale allowed for the completion of the second study in this programme of research (Chapter 3), which investigated collective emotion and interpersonal emotional convergence in sport dyads. In this study, the pre, during, and post-competition emotional states of doubles table tennis athletes were recorded, as well as subjective and objective performance measures, and responses to the Contagion of Affective Phenomena Scale (Clarkson et al., 2021). A partial Intra-class Correlation Coefficient

analysis method, novel to sport research, was then used to assess the extent to which the dyads exhibited emotional aggregation. Evidence of within-dyad emotional aggregation was found for the athletes' happiness and dejection *during* the match and for the athletes' happiness, dejection and anger *immediately following* the match. Theories of emotional contagion were used to explain the evidence of emotional aggregation and that the pairs' emotions further converged as the match progressed. These findings represent the first evidence that interpersonal emotional aggregation and convergence are present in dyadic sport, and the first time that both positive and negative emotional states have been found to emotionally aggregate during sporting competition.

Chapter 4 comprised an examination of the role of olfactory functioning (olfactory threshold and identification), and individual attitudes to olfaction, in affecting the emotional aggregation of two co-operating friends. The pairs completed a virtual doubles tennis match and a jigsaw puzzle together, and their emotions were measured before, during, and after these tasks took place. Individual differences in participants' attitudes about the importance of their own sense of smell affected the extent to which emotional aggregation with their partner occurred. That is, participants who used their sense of smell more in their everyday life recorded higher within-dyad emotional aggregation. This is the first evidence that individual characteristics may affect the susceptibility for olfactory facilitated emotional contagion to occur

The final study in this programme of research (Chapter 5) details a qualitative exploration of the EASI model in paired frontline ambulance service relationships. A critical realist approach was adopted in order to analyse the participants' interviews and voice diaries using both abductive and retroductive methods. These techniques revealed evidence of the Affective Reactions and Inferential Processes associated with the EASI model, and contributory factors affecting these processes were also identified. These factors were shown

to impact upon the emotional influence enacted by the ambulance service staff and included; the nature of the dyadic relationship, individual differences in emotional concepts, organisational expectations, and the situational contexts of callouts. These findings therefore provide the first evidence that interpersonal emotional influence exists in emergency services dyads.

6.2 Insights for Emotion Measurement

Emotion measurements in sport research are largely conducted using the Sport Emotion Questionnaire (SEQ; Jones et al., 2005) and the Brunel Mood Scale (BRUMS; Terry et al., 1999), or a non-sport specific emotion questionnaire such as the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) or the Profile of Mood States (POMS; McNair et al., 1971). Each of these questionnaires hold value, and for sport-related work, the SEQ is a well utilised method of assessing athletes', specifically pre-competition, emotions. Nevertheless, these questionnaires do not present valid and feasible means of measuring athletes' in-competition emotions. As a result, the BICE scale (Chapter 2), developed for this programme of research, now represents the best scale for the assessment of athletes' in-competition emotional states.

The first benefit of the BICE scale is that it allows for in-competition specificity with the inclusion of emotion items relevant for the assessment of athletes' in-competition emotions. By utilising the initial item list from the SEQ, it ensured that the items included in the BICE scale development process were relevant to sport and theoretically supported. The decision to use both sport psychology experts and a large athlete population to reduce the number of items, and to confirm that the scale was in-competition specific, is well supported in the literature (Carpenter, 2018) and allowed for a demonstration of the scale's validity and specificity for sport (Lane et al., 2012). Therefore, the development of the BICE scale advances the literature through providing an additional emotion questionnaire specifically

relevant to sport with an item list established using sport specific methods. This specificity allays some of the criticisms levelled at previous non-sport specific measures used in the sport emotion literature (Jones et al., 2005; Lane et al., 2012). Additionally, a number of researchers have suggested that the lack of a sport emotion measure relevant to in-competition measurement has allowed for less valid assessments of sport emotion using either post-competition recall or the use of non-specific questionnaires (Campo et al., 2019). The BICE scale promotes a method which combats these methodological issues.

The second key benefit of the BICE scale is its practicality for use in quickly and easily assessing emotion in-competition. The BICE scale consists of ten items which is considerably shorter than the SEQ, the BRUMS and the PANAS. Nevertheless, in convergent validity assessments, the BICE scale was shown to assess emotion in a comparable manner to that of the BRUMS and the PANAS. The ease with which athletes can complete questionnaires has been shown to be key in their attitudes towards research and may impact upon the data that they provide (Horvath & Roblin, 2010). Furthermore, the brief nature of the scale offers the possibility for the collection of longitudinal emotion data without requiring athletes to complete long arduous questionnaires multiple times. The practical benefits of the BICE scale were demonstrated in Chapter 3 of this thesis, in which the BICE scale was used to collect emotion data easily between games 2 and 3 of doubles table tennis matches. The official interval time allowed during these breaks was only 1 minute and the BICE scale was completed very quickly by athletes in these time sensitive scenarios. In addition, the study in Chapter 3 comprises a longitudinal emotion questionnaire measurement design, for which the BICE is also ideally suited. Owing to the scale's brief nature, the participants were not discouraged by the requirement to complete the BICE scale three times in relatively quick succession. Consequently, the data collected in that study could be used to better investigate the research question. The benefits to the design of the BICE scale provide

many avenues for future research which have otherwise not been possible. Further investigations regarding specifically interpersonal emotional influence in sport can now be undertaken as a result of the development of this questionnaire (Freemantle et al., 2021).

The BICE scale is geared to measure specifically emotion, while other scales used in sport research such as the Profile of Mood States or the Positive and Negative Affect Schedule assess mood and affect respectively. These terms are conceptually different, although they are occasionally used interchangeably in the literature (Lane et al., 2011). The development of a questionnaire which focuses on emotions, rather than moods, allows researchers to be confident in their assessment of emotion. This approach also recognises that emotions are transient, ever-changing concepts, and therefore a scale relevant to these brief feelings assist researchers in better examining athletes' emotional experiences.

6.3 Insights in relation to the Emotions as Social Information (EASI) Model

The Emotions as Social Information Model (EASI: Van Kleef, 2009) outlines the processes via which individuals' emotional displays can impact upon observers through Affective Reactions and Inferential Processes. The research presented in Chapters 3, 4 and 5 highlights the interpersonal emotional influence that individuals can exert on their partners in performance dyad situations. Each of the three chapters examined processes involved in Affective Reactions, and Chapter 5 also included an exploration of Inferential Processes. Factors affecting both Affective Reactions and Inferential Processes were additionally examined in this programme of research.

6.3.1 Emotional Contagion in Performance Dyads.

Interpersonal emotional transfer, of which emotional contagion is a key theory, is a key component of the emotional influence described in the EASI model (Van Kleef, 2009). In this thesis, evidence of within-dyad emotional transfer was demonstrated in the relationships of table tennis doubles pairs (Chapter 3), collaborating friend dyads (Chapter 4) and

ambulance service partners (Chapter 5). Early laboratory research investigating interpersonal emotional transfer often focused on identifying evidence in dyadic relationships (Kelly & Barsade, 2001). Yet, in more recent applied examinations in performance domains, dyadic relationships have been largely overlooked. As a result, the findings presented in this thesis are important in recognising the prominence of the performance dyad relationship in applied contexts and exploring the interpersonal emotional transfer experiences of these dyads.

Previous evidence of emotional aggregation, and the suggestion of interpersonal emotional transfer, has been presented in sport. For instance, Rumbold et al. (2021) found that soccer players' emotional states were associated with those of their teammates following a match and Totterdell (2000) showed that cricket teammates' moods were aggregated while playing a cricket match together. The findings presented in Chapter 3 showed that doubles table tennis athletes' ratings of Happiness, Dejection and Anger were significantly associated with their partner's emotions and that the pairs' emotional states further converged as the competition progressed. This evidence of emotional aggregation indicates that the necessary prerequisites for interpersonal emotional transfer are present in dyad team scenarios as they compete, just as they are also present for larger sports teams (Moll et al., 2011; Totterdell, 2000). Approximately a third of the sports at the Tokyo 2020 Olympics consisted of events that involved formal dyadic teams. Similarly, larger team sports will often include informal dyadic partnerships such as the two defensemen in Ice Hockey or the goal shooter and goal attacker working co-operatively in Netball. As a result, it is clear that a better understanding of these dyadic teams' emotional relationships and interpersonal emotional convergence can benefit the field.

In Totterdell's (2000) study he found evidence that cricket teammates' positive moods could be caught and transferred throughout the team. This was important as it was the first evidence that affective contagion was present in sport. Totterdell described this phenomenon

as mood linkage, owing to the transfer of a combined positive affect. In Chapter 3, a range of emotional states (Happiness, Dejection and Anger) were found to interpersonally converge, rather than general mood states as Totterdell showed. A sport such as cricket is slower paced than table tennis, and the cricket matches investigated in Totterdell's (2000) study lasted approximately 4 days, therefore in that context it was useful to consider the moods of the athletes. In sports which feature shorter matches, and which are played at pace (e.g., table tennis, badminton and soccer), the athletes' brief emotional experiences are likely of more interest to researchers and may be more prominent in interpersonally influencing teammates. The evidenced interpersonal influence of specifically emotional states highlights the importance of measuring the transient emotions that athletes experience while competing in sport and further emphasises the role of the BICE scale in future interpersonal emotion investigations.

The findings in Chapter 3, which indicate within-dyad associations for both positive and negative emotions, advances Totterdell's (2000) study which only found evidence of emotional aggregation for a cricket teams' positive affect. Rumbold et al. (2021) previously presented evidence for the transfer of positive emotions, as well as negative emotions, following a soccer match. Nevertheless, the findings of the present thesis show that emotional valence does not affect the tendency for an emotion to be interpersonally transferred in an in-competition context.

The performance dyads sampled in Chapter 4 worked collaboratively to achieve success in two tasks (virtual doubles tennis and a jigsaw puzzle). The participants showed within-dyad emotional aggregation across positive and negative affect following the tennis task and for positive affect only following the collaborative jigsaw puzzle task. These results indicate that the shared emotions that the dyads experienced at these time points were distinct from the emotions that other dyads experienced at the same point in the study procedure. This

evidence of within-dyad affective aggregation suggests that performance dyad-specific interpersonal emotional transfer can be identified using laboratory-based tasks rather than requiring naturally occurring, emotionally stimulating events such as competitive sports matches. This is particularly relevant if there are methodological or practical barriers to undertaking research in the field.

Although the studies outlined in Chapter 3 and Chapter 4 show evidence of emotional aggregation and convergence, because of the methodologies used, evidence of the emotional contagion process is not explicitly apparent. The study designs utilised multiple emotion measures rather than controlling participants' exposure to emotions (see Volmer, 2012). Explanations to address this limitation are twofold. First, theories of emotional contagion were used to explain the identified emotional aggregation in these two chapters as a result of the large body of previous work suggesting evidence of emotional contagion in performing contexts (Cheng et al., 2012; Cotterill et al., 2021; Petitta et al., 2017; Totterdell, 2000; Uy et al., 2020; Van Kleef et al., 2019) and considerable evidence of olfactory facilitated emotional contagion (de Groot et al., 2017). Second, this limitation can be addressed in the context of the statistical analysis techniques utilised. In Chapter 3, the analysis assessed the within-dyad emotional convergence and cases of unexplained emotional variance. Consequently, evidence of collective emotional states was provided although the exact cause of these collective emotions was not explicitly clear. In order to better explain this aggregated emotion, the athletes' objective and subjective experiences of their match were controlled for whilst calculating the emotional aggregation. Therefore, this suggests that the collective emotions did not occur simply because of the pairs' simultaneous experiences of their match but instead interpersonal emotional transfer processes (i.e., emotional contagion) were likely also present. This is a statistical method adopted in other previous investigations of emotional transfer (Rumbold et al., 2021; Totterdell, 2000). Moreover, in Chapter 4 the multi-level

mediation model identified the role of olfaction in the within-dyad emotional aggregation whilst controlling for the pairs' experience of the task. These findings also suggest that the measured similarity occurred, in part, through processes that were unrelated to the pairs' shared experiences.

6.3.2 Inferential Processes and Affective Reactions in the Ambulance Service

In the qualitative study presented in Chapter 5, the sampled frontline ambulance service employees discussed experiencing both the Inferential Processes and Affective Reactions outlined in the EASI model (Van Kleef, 2009). These influential interpersonal processes were demonstrated by participants' reports of emotional contagion, interpersonal emotion regulation, emotional displays affecting crewmates' emotions, and a range of non-verbal, within-dyad, emotional communication. Consequently, this thesis represents the first evidence of the interpersonal emotional processes of the EASI model in collaborative emergency services teams. Evidence of EASI model processes has been presented in similar contexts (e.g., nursing, Moran, 2013; police/offender relationships, van Gelderen et al., 2011). However, these studies have not investigated how co-operative emergency services personnel can affect each other's emotions and behaviours through their emotional displays. As a result, the findings presented in this thesis provide further support for the theories of the EASI model (Van Kleef, 2009) and break new ground in identifying interpersonal emotional influence in applied domains. Emergency services personnel work in a highly emotive performance context which involves high risk consequences. In expanding on the previous identification of interpersonal emotional influence in other less intense domains (e.g., business, Cole et al., 2008), the findings from Chapter 5 suggest that those individuals who live and work in environments which can create emotionally intense reactions are likely to express their emotions and influence observers. This is key in promoting future research to investigate the interpersonal emotional experiences of groups in other demanding job roles.

In Chapter 5, the participants were found to interpersonally transfer a variety of emotions to and from their partners through the Affective Reactions process of the EASI model. This affect consisted of negative emotions, such as frustration and anger, as well as positive emotions such as happiness and cheerfulness. Similarly, there were instances of interpersonal emotional regulation reported by participants in regulating a range of their partners' emotional states. For example, the ambulance service staff described calming stressed partners down and trying to cheer partners up if they were feeling upset. Van Kleef (2010) previously posited that an individual's depth of processing acts as a key component in deciding whether influence associated with Affective Reactions, rather than Inferential Processes, is demonstrated. Yet, the findings in Chapter 5 did not indicate differences in the participants' attention and cognitive load related to their dyad partners' emotional displays. It has also been suggested that the adoption of interpersonal emotional regulation in teams is due to either altruistic reasons (to support the emotional expresser) or egoistic benefits (to improve team performance) (Campo et al., 2017). Nonetheless, evidence from Chapter 5 showed negative emotions being transferred from one crewmate to another where one would expect partners to instead attempt to regulate those negative emotions, if considering either egoistic or altruistic reasons. As a result, the procedures behind the adoption of Affective Reactions and Inferential Processes requires future investigation.

6.3.3 Factors Affecting EASI Model Processes

In the present thesis, two studies were conducted to identify factors which affect the facilitation of interpersonal emotional influence. First, Chapter 4 identified individual differences in the olfactory facilitated emotional contagion process. The evidence presented in Chapter 4 showed that a participant's score on the Importance of Olfaction Questionnaire (IOQ; Croy et al., 2010) acted as a contributory factor in predicting their susceptibility to experiencing emotional aggregation. These findings significantly extend the literature as the

study methodology was the first to assess individual differences in olfactory functioning in relation to the applied interpersonal transfer of emotion. For instance, evidence from Chapter 4 significantly develops that of Haviland-Jones et al. (2016), who showed that there were individual differences in the detection of socially relevant odours, as Chapter 4 focused on the applied influence that social odour detection had on the participants' experienced emotional aggregation. The attitudes assessed in the IOQ concentrate, in part, on the aspects of olfaction that capture the social-odour association. As such, it is theorised that the olfactory functioning tests (identification and threshold) may not have affected the participants' emotional aggregation as these tests do not assess any aspect of the social-olfaction emphasis that is present in the IOQ. It was surprising that tests of olfactory system functioning did not affect the measured emotional aggregation, although future studies using socially relevant target odours in a threshold or identification test may be more indicative of individuals' susceptibility to emotional aggregation. Despite this, the present thesis demonstrates that the IOQ can be used to measure individuals' susceptibility to experiencing olfactory facilitated emotional contagion. Additionally, owing to the natural, applied methodology adopted in Chapter 4, it was shown that olfactory-facilitated emotional transfer was present while pairs simply took part in active tasks together in close proximity. Consequently, this indicates that olfactory-facilitated emotional contagion can occur regularly in group situations, further highlighting the importance of identifying a factor that can affect this process.

The qualitative exploration of interpersonal emotional influence in the ambulance service presented in Chapter 5 identified social contextual factors which impacted upon the propensity for frontline staff to experience EASI model Affective Reactions and Inferential Processes. Emergent themes included the dyadic relationship, individual differences in emotional concepts, organisational expectations, and the situational contexts of callouts.

Evidence presented in the literature to identify factors affecting the presence of EASI model processes has been contradictory at times. For instance, Hatfield et al. (2014) reported that they were unable to replicate findings showing that in-group factors and interpersonal liking affected Affective Reactions (e.g., Kimura et al., 2008). Nevertheless, the present thesis supported arguments that the relationship between partners is relevant in affecting the susceptibility for interpersonal emotional influence. The ambulance service employees who reported being close in their relationship and who had spent more time together were better at identifying their partner's emotions and more likely to demonstrate Affective Reactions and Inferential Processes in their presence. In addition to the findings from Chapter 4, individual differences were also identified as affecting the EASI model processes in ambulance service dyads in Chapter 5. The extent to which the ambulance service employees expressed their emotions, and the individual techniques that they used to regulate their emotions, both impacted upon their susceptibility to experience Affective Reactions and Inferential Processes at work. This supports evidence from other applied investigations which demonstrate the important role that individuals' emotional expressivity can play in influencing others' emotions (Berrios et al., 2015).

Moreover, the findings from Chapter 5 support the theory that the contexts in which individuals are situated, and in which they experience emotions, can affect the enaction of EASI model processes. For instance, the presented findings identified contexts and factors which were impactful in affecting interpersonal emotional concepts in specifically the emergency services. This specificity was achieved through the critical realist approach adopted in Chapter 5 which focuses on investigating the specific settings of interest. Previous literature has described the effect of specific contextual factors on interpersonal emotional influence, such as the impact of team roles in the exhibition of interpersonal emotional regulation in sport (Tamminen & Crocker, 2013). Nevertheless, those contextual factors

have, by definition, been specific to the context and domain in which the investigations have taken place. Therefore, the findings from this thesis extend the literature by assessing contexts relevant to a new domain not yet investigated: the emergency services.

Factors affecting EASI model interpersonal emotional processes have not been widely identified in performance domains. Therefore, the evidence presented in this thesis which outlines trait, social, and contextual factors that can influence the existence of EASI model processes significantly advances the understanding of interpersonal emotional influence in these domains.

6.4 Applied Implications

This research programme was undertaken with a focus on investigating applied instances of interpersonal emotion concepts. As such, there are a number of applied implications as a result of the thesis findings. Chapter 2 consisted of the development and initial validation of the Brief In-Competition Emotion scale (Freemantle et al., 2021). The assessment and investigation of athletes' emotions while competing is an important consideration for practicing sport psychologists (Friesen, 2021; Wagstaff & Tamminen, 2021). Although some emotion questionnaires currently support applied sport psychology practitioners in emotional assessment, the BICE scale provides a valid and practical method of measuring a new aspect of sport emotion: in-competition emotions. The applied benefits of the development of the BICE scale are most prominent in the parsimonious characteristics of the questionnaire. The brief 10-item questionnaire design allows practitioners and researchers to undertake emotion measures in time-constrained scenarios. This unique design ensures athletes can be assessed using more frequent measurement time points as the scale is brief enough to be administered during the official intervals of most sports. Therefore, the BICE scale provides a tool capable of measuring the transient fluctuation of athletes' emotional experiences which is not possible without a brief enough scale that can be utilised

longitudinally. The issue of not being able to measure fleeting athlete emotions during competition has been voiced elsewhere (Campo et al., 2019; Uphill et al., 2012), and is also problematic in the applied field. In sum, the BICE scale allows practitioners to assess and understand the effectiveness of different emotional interventions which would otherwise not be possible.

Investigations of the influence of both conscious and unconscious emotional displays in performing dyad relationships were conducted throughout this thesis. In sport, emotional convergence was identified for the first time for doubles table tennis pairs while they competed. Evidence of the concept of interpersonal emotional transfer in sports dyads assists coaches and practitioners in better understanding the development processes of collective team emotions. Currently, research investigations into collective and converged emotions in sports teams are sparse, thus applied practitioners may not be able to provide interventions rooted in evidence. Consequently, the findings presented in this thesis assist applied professionals in considering the role of interpersonal emotional concepts in the development of athletes' shared emotional states. Evidence from Chapter 3 indicates that coaches, athletes and professionals should be just as wary of the transfer of negative emotions as they are hopeful for the transfer of positive emotions. As outlined in the 'team collapse' literature (Wergin et al., 2019), athletes who exhibit negative emotions can cause their teammates to feel similarly negative. As a result, the empirical support provided by Chapter 3 further highlights that negative individuals should be emotionally supported and aided in order to avoid a negative emotional state transferring throughout the team.

The results from Chapter 5 provide comparable recommendations for emergency services staff. Frontline ambulance personnel were affected by their crewmates' emotional displays which led to both beneficial and damaging instances of Affective Reactions and Inferential Processes. Thus, ambulance service organisations should be wary of both

controlled and un-controlled emotional displays affecting the crewmate relationship and the behaviour of frontline staff. The ambulance pairs discussed the intense emotional situations that they experience on shift. If one member of the pair were to be negatively affected by these experiences, then these emotions may subsequently impact on their partner if not managed considerately. Therefore, both frontline staff and management should be aware of the interpersonal emotional influence instances outlined in this thesis and strive to regulate and discuss negative emotions in a constructive manner. Additionally, it was shown in Chapter 5 that four facilitative factors affected the EASI model processes. These factors were the dyad relationship, individual differences in emotional concepts, organisational expectations, and the situational contexts of callouts. Ambulance service employees could use these themes and the associated subthemes to identify individuals, pairs and situations where interpersonal emotional influence may be most pronounced. Any preparation and identification of causal factors by ambulance service staff will help to create positive emotional environments and avoid some of the negative group affective states, such as collective burnout, described in other applied healthcare settings (see Bakker et al., 2001; Martinez-Inigo et al., 2007; Pettita et al., 2016). Consequently, these findings have the potential to provide multiple benefits for the ambulance service in providing a high level of care for patients whilst maintaining positive interpersonal emotional experiences for ambulance crew members.

6.5 Limitations

In addition to the study-specific limitations presented throughout the thesis, there were limitations which were relevant to the thesis as a whole. Chapters 2, 3 and 4 outline the development and administration of questionnaires for use in assessing participants' emotional states. However, there are limitations to using quantitative questionnaires for this task (Lane et al., 2012), as such tools are limited in the range of subjective emotions that they can

measure (i.e., the number of items in a questionnaire). Qualitative explorations can record detailed accounts of emotional experiences as participants are provided with the opportunity to discuss relevant emotions that come to mind (e.g., Drewitz-Chesney, 2019; Martinent & Ferrand, 2015). As such, the mixed-methods approach adopted in this research programme was chosen with regard to the methods' respective merits. The questionnaires administered in Chapters 2, 3 and 4 provided a normative measure which could be easily used to quantitatively calculate the participant dyads' emotional aggregation values and directly compare the dyads' emotional convergence. The questionnaires utilised in these investigations (the BICE scale and the PANAS) covered a range of relevant emotions broad enough to provide a useful insight into the participants' emotional states. The qualitative methodology adopted in Chapter 5, which also placed a focus on identifying emotional states, allowed for a broader exploration of the emotions experienced by frontline ambulance staff.

Researchers have asserted that collective emotional states in groups can be developed through both top-down and bottom-up processes (Collins et al., 2013; Kelly & Barsade, 2001). The theoretical stance of this thesis was principally grounded in a bottom-up emergent construct approach to investigate collective emotions. This approach allowed for a focus on the socially interactive development processes of the EASI model and an investigation of whether these processes were specifically experienced in the performance domains assessed. Nevertheless, researchers have outlined other processes that can help to construct collective emotional states such as Cumulative Constructs, the development of group affect by groups consisting of individuals with pre-existing similar individual affective tendencies, and Contextual Constructs, which refers to the development of group affect that is imposed solely on the group from external sources such as socialisation (Collins et al., 2013; Cronin et al., 2011). It is therefore the case that these other, less socially interactive processes, may have also contributed to the development of the collective emotions identified and measured in this

programme of research. Although interesting, these alternative approaches were not key aspects of the thesis objectives and may therefore be better investigated in future research.

6.6 Future Directions

It has been shown that interpersonal emotional influence occurs in dyadic performance partnerships, additionally, factors influencing this process have been revealed. However, future research should explore whether partnerships that experience increased interpersonal emotional influence are more successful in pursuing their aims. For example, when considering emotional contagion, Totterdell (2000) found that cricket players' self-assessments of their performance was better when the aggregate happiness of their teammates was higher. Although perhaps indicative of an association between collective emotion and performance, this finding pertains more to the extent to which the team are happy rather than the degree to which their emotions are aggregated. Consequently, an investigation regarding whether objective team performances are affected by the extent to which teammates present aggregated emotion through interpersonal influence (whether positive or negative) would uncover further benefits of an emotionally attuned team.

Chapters 3 and 4 examined and presented evidence of participants demonstrating Affective Reactions, while the findings from Chapter 5 showed that the ambulance service dyads experienced both Affective Reactions and Inferential Processes. Van Kleef argued that the demonstration of either process may be related to whether the emotional expresser is collaborative with, or competitive toward, the observer (Van Kleef et al., 2004), although this was not the case in the ambulance service. Additionally, the demonstration of one process rather than another may be due to the depth with which the emotional display is processed (Van Kleef, 2009). Future research should aim to identify factors that affect whether individuals experience Affective Reactions or whether Inferential Processes are practised.

These investigations would help to further explain what causes the differences in interpersonal influence enacted by expressers' emotional displays.

6.7 Conclusion

In conclusion, the present thesis has utilised both quantitative and qualitative methods to present evidence for interpersonal emotional influence in performance dyads and revealed novel factors affecting these processes. Additionally, through developing a brief sport-specific emotion questionnaire, the emotional aggregation experiences of doubles table tennis pairs were more accurately measured.

This programme of research advances the literature in multiple ways. Firstly, the evidence presented in this thesis shows that dyads across multiple performance domains are interpersonally affected by their teammates' emotional displays, as explained by the Emotions as Social Information model (Van Kleef, 2009). This interpersonal emotional influence has not previously been identified for dyadic relationships in sport or in any collaborative teams in the emergency services. This is important as both sport and emergency services dyads are consistently involved in emotionally intense situations which can lead to emotional displays. As a result of the findings from this thesis, it is clear that these emotional displays are not solely relevant to the individual and can in fact impact upon collaborative partners.

Secondly, two studies from this thesis have identified key factors found to affect the prevalence of Affective Reactions and Inferential Processes. A trait individual difference characteristic (the IOQ) was found to affect the extent to which a pairs' emotions aggregated whilst completing collaborative tasks. This is the first time that a personal characteristic has been found to impact upon the olfactory facilitated emotional transfer process. Assessing individuals using the Importance of Olfaction Questionnaire (Croy et al., 2010) could be helpful in predicting their susceptibility to experiencing emotional contagion. Factors specific

to the ambulance service were also identified, which affect the extent to which ambulance service dyads experience EASI model processes. Consideration of these factors might help employers to ascertain which partnerships, contexts, and individuals may be more prone to emotional convergence.

The final contribution of this thesis to the field, is the development of the Brief In-Competition Emotion scale (Chapter 2, Freemantle et al., 2021) which can now be used by researchers and applied practitioners alike to assess the subjective emotions that athletes experience whilst they are competing.

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Appendices

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Appendix A: A copy of the Brief In-Competition Emotion Scale (Chapter 2)

The Brief In-Competition Emotion Scale

Below you will find a list of words that describe a range of feelings that sport performers may experience *during competition*. Please read each one carefully and indicate on the scale next to each item how you feel *right now, at this moment, in relation to your current competition*.

There are no right or wrong answers. Do not spend too much time on any one item but choose the answer which best describes your feelings right now in relation to your current competition.

	Not at all	A little	Moderately	Quite a bit	Extremely
Frustrated	0	1	2	3	4
Anxious	0	1	2	3	4
Energetic	0	1	2	3	4
Unhappy	0	1	2	3	4
Cheerful	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Disappointed	0	1	2	3	4
Nervous	0	1	2	3	4
Irritated	0	1	2	3	4
Happy	0	1	2	3	4

Scoring Instructions:

Anxiety = anxious + nervous

Anger = frustrated + irritated

Dejection = unhappy + disappointed

Excitement = enthusiastic + energetic

Happiness = happy + cheerful

Appendix B: Description of the Syntax used in the Multilevel Mediation Model (Chapter 3)

Appendix B

MPLUS syntax for the 1-1-2 MSEM mediation model utilised in the present study.

```
USEVARIABLES ARE A B C D E F;  
CLUSTER IS A;  
BETWEEN ARE D E;  
ANALYSIS: TYPE IS TWOLEVEL;  
ESTIMATOR = MLR;  
MODEL:  
%WITHIN%  
C ON B;  
%BETWEEN%  
D on C(b)  
E  
F  
B;  
C on B(a);  
MODEL CONSTRAINT:  
NEW(ab);  
ab=a*b;  
OUTPUT: TECH1 TECH8 CINTERVAL;
```

A = Dyad

B = Sum Threshold Identification Score

C = Importance of Olfaction Score

D = $r_{WG(j)}$ Positive Emotion Agreement Scores (During-Task Time Point)

E = Wii Performance Score

F = Closeness to Partner

Appendix C: Ethical Approval (Chapters 2, 3, 4 and 5 and Form UPR16)

C.1 Chapter 2 Ethical Approval

C.2 Chapter 3 Ethical Approval

C.3 Chapter 4 Ethical Approval

C.4 Chapter 5 Ethical Approval from University of Portsmouth and NHS HRA

C.5 UPR16 form

Appendix C.1: Chapter 2 Ethical Approval



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20 December 2018

FAVOURABLE ETHICAL OPINION – WITH CONDITIONS

Study Title: The Development and Validation of a Short Form Sport Emotion Questionnaire

Reference Number: SFEC 2018-127

Date Submitted: 04 December 2018

Thank you for submitting your application to the Science Faculty Ethics Committee (SFEC) for ethical review in accordance with current procedures.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (*See Annex B*), and the following specific minor conditions:

Conditions¹

A. The sample sizes mentioned across sections 11.1 – 11.3 are not consistent. Please address this inconsistency.

B. 11.4. If the Student Survey Request Group do ask for changes to the protocol, SFEC must be informed and this may require an amendment to be submitted.

C. In the PIS change the 'Department of Psychology's Research Ethics Committee' to the 'Science Faculty Ethics Committee'

D. In the PIS it is stated that, 'The researchers have chosen to sample sport science students owing to their assumed experience levels within sport. It is hoped that each student will have competed in competitive sporting contests.' The wording in this section is inappropriate. It cannot be 'assumed' that students will have competed in competitive sporting contests. Several may not for various reasons, e.g. medical. Please amend this

¹ The favourable opinion given is dependent upon the study adhering to the conditions stated, which are based on the application document(s) submitted. It is appreciated that Principal Investigators may wish to challenge conditions or propose amendments to these. In that case, please consider the favourable opinion *suspended*, and simply make your case for amending or discarding conditions in writing as you would an application resubmission following ethical review.

section and carefully consider the individuals within the group who will not have competed in sport.

E. For accuracy, change "PhD researcher" to "PhD student" and "Portsmouth University" to "University of Portsmouth."

F. In Section 8.2, concerning the second and third phases of the research--specifically, the researchers write that, "It will be made clear to the students that should they wish to leave the lecture theatre before the research begins they will be free to do so without giving a reason and with no repercussion." That wording could be interpreted as meaning that researchers might expect that anyone who declines to participate will leave the lecture theatre, and will therefore expect anyone who remains in the lecture theatre to participate in the study. However, since some students may not wish to be so public in declining to participate, the researchers should also stress students who remain in the lecture theatre are likewise free to decline to participate.

Advisory Note

These advisory notes are given in good faith and it is hoped they are accepted as such. You do not need to adhere to these comments, or respond to them, unless you wish to.

i. We would suggest that it is extremely optimistic and unlikely that the PI will recruit 200 participants from L4 and L5 sports science (~50% of cohort) and 100 from L6 sports science (again ~50% of cohort). It is important that the students are aware that it is not mandatory to do this study and that there is no coercion involved.

Please resubmit an updated application form incorporating the changes as per the above conditions for the final SFEC records on this application.

If you would find it helpful to discuss any of the matters raised above or seek further clarification from a member of the Committee, you are welcome to contact ethics-sci@port.ac.uk who will circulate your queries to SFEC

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research



Dr Paul Morris
Vice Chair Science Faculty Ethics Committee

Appendix C.2: Chapter 3 Ethical Approval



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17 July 2019

FAVOURABLE ETHICAL OPINION – WITH CONDITIONS

Study Title: An investigation into the prevalence of emotional contagion within the performance dyadic relationships of competing racquet sport doubles partners

Reference Number: SFEC 2019-066

Date Submitted: 1 July 2019

Thank you for submitting your application to the Science Faculty Ethics Committee (SFEC) for ethical review in accordance with current procedures.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (See *Annex B*), and the following specific minor conditions:

Condition(s)¹

A. In the PIS section about “**What will happen if I don’t want to carry on with the study?**”, please indicate that if any of the 4 competing athletes decide to withdraw from the study, then the other 3 are automatically excluded for information.

B. In the PIS section about “**Are there any possible disadvantages and risks of taking part?**”, please add at the end that it is possible that negative emotions are drawn.

Please resubmit an updated application form incorporating the changes as per the above conditions for the final SFEC records on this application.

¹ The favourable opinion given is dependent upon the study adhering to the conditions stated, which are based on the application document(s) submitted. It is appreciated that Principal Investigators may wish to challenge conditions or propose amendments to these. In that case, please consider the favourable opinion *suspended*, and simply make your case for amending or discarding conditions in writing as you would an application resubmission following ethical review.

If you would find it helpful to discuss any of the matters raised above or seek further clarification from a member of the Committee, you are welcome to contact ethics-sci@port.ac.uk who will circulate your queries to SFEC

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research

Helena Herrera

Dr Helena Herrera
Vice Chair Science Faculty Ethics Committee

Appendix C.3: Chapter 4 Ethical Approval



Mr Alexander Freemantle
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University of Portsmouth

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10 October 2019

FAVOURABLE ETHICAL OPINION – WITH CONDITIONS

Study Title: An Investigation Into the Relationship Between an Individual's Olfactory Ability and their Susceptibility to Emotional Contagion

Reference Number: SFEC 2019-090

Date resubmitted: 8 October 2019

Thank you for resubmitting your application to the Science and Health Faculty Ethics Committee (SFEC) for ethical review in accordance with current procedures and for making the requested changes following the first SFEC review, and for the clarifications provided.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (*See Annex B*), and the following specific minor condition.

Condition¹

A. Remove references to an ECG if this is not necessary

Please resubmit an updated application form incorporating the changes as per the above conditions for the final SFEC records on this application.

If you would find it helpful to discuss any of the matters raised above or seek further clarification from a member of the Committee, you are welcome to contact ethics-sci@port.ac.uk who will circulate your queries to SFEC

¹ The favourable opinion given is dependent upon the study adhering to the conditions stated, which are based on the application document(s) submitted. It is appreciated that Principal Investigators may wish to challenge conditions or propose amendments to these. In that case, please consider the favourable opinions *suspended*, and simply make your case for amending or discarding conditions in writing as you would an application resubmission following ethical review.

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research.

Helena Herrera

Dr Helena Herrera
Vice Chair Science and Health Faculty Ethics Committee

C.4 Chapter 5 Ethical Approval from University of Portsmouth and NHS HRA



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ethics-sci@port.ac.uk 11 November 2020

FAVOURABLE ETHICAL OPINION – FOLLOWING RESUBMISSION

Study Title: An Exploration of Performance Dyads' Emotional Experiences

Reference Number: SHFEC 2020-080

Date Resubmitted: 9 November 2020

Thank you for resubmitting your application to the Science and Health Faculty Ethics Committee (SHFEC) for ethical review in accordance with current procedures, for making the requested changes following the first SHFEC review, and for the clarifications provided.

I am pleased to inform you that SHFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (*See Annex B*).

Please note that the favourable opinion of SHFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research

A handwritten signature in black ink, appearing to read 'JK' followed by a flourish.

Dr Juliane Kaminski
Vice Chair, Science and Health Faculty Ethics Committee

NHS HRA Approval Letter



Ymchwil Iechyd
a Gofal Cymru
Health and Care
Research Wales



Mr Alexander Freemantle

Email: approvals@hra.nhs.uk
HCRW.approvals@wales.nhs.uk

08 January 2021

Dear Mr Freemantle

**HRA and Health and Care
Research Wales (HCRW)
Approval Letter**

Study title: An Exploration of Performance Dyads' Emotional Experiences
IRAS project ID: 293429
Protocol number: SHFEC 2020-080
REC reference: 20/HRA/6255
Sponsor: University of Portsmouth

I am pleased to confirm that [HRA and Health and Care Research Wales \(HCRW\) Approval](#) has been given for the above referenced study, on the basis described in the application form, protocol, supporting documentation and any clarifications received. You should not expect to receive anything further relating to this application.

Please now work with participating NHS organisations to confirm capacity and capability, in line with the instructions provided in the "Information to support study set up" section towards the end of this letter.

How should I work with participating NHS/HSC organisations in Northern Ireland and Scotland?

HRA and HCRW Approval does not apply to NHS/HSC organisations within Northern Ireland and Scotland.

If you indicated in your IRAS form that you do have participating organisations in either of these devolved administrations, the final document set and the study wide governance report

(including this letter) have been sent to the coordinating centre of each participating nation. The relevant national coordinating function/s will contact you as appropriate.

Please see [IRAS Help](#) for information on working with NHS/HSC organisations in Northern Ireland and Scotland.

How should I work with participating non-NHS organisations?

HRA and HCRW Approval does not apply to non-NHS organisations. You should work with your non-NHS organisations to [obtain local agreement](#) in accordance with their procedures.

What are my notification responsibilities during the study?

The "[After HRA Approval – guidance for sponsors and investigators](#)" document on the HRA website gives detailed guidance on reporting expectations for studies with HRA and HCRW Approval, including:

- Registration of Research
- Notifying amendments
- Notifying the end of the study

The [HRA website](#) also provides guidance on these topics and is updated in the light of changes in reporting expectations or procedures.

Who should I contact for further information?

Please do not hesitate to contact me for assistance with this application. My contact details are below.

Your IRAS project ID is **293429**. Please quote this on all correspondence.

Yours sincerely,
Rekha Keshvara

Approvals Manager

Email: approvals@hra.nhs.uk

Copy to: *Mr Alexander Freemantle*

FORM UPR16

Research Ethics Review Checklist

Postgraduate Research Student (PGRS) Information		Student ID:	UP875774
PGRS Name:	Alexander William Joe Freemantle		
Department:	Psychology	First Supervisor:	Dr Lorenzo Stafford
Start Date: (or progression date for Prof Doc students)	01/10/2018		
Study Mode and Route:	Part-time <input type="checkbox"/>	MPhil <input type="checkbox"/>	MD <input type="checkbox"/>
	Full-time <input checked="" type="checkbox"/>	PhD <input checked="" type="checkbox"/>	Professional Doctorate <input type="checkbox"/>

Title of Thesis:	Interpersonal Emotional Influence in Performance Dyad Relationships
Thesis Word Count: (excluding ancillary data)	41763

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University's Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

UKRIO Finished Research Checklist:

(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: <http://www.ukrio.org/what-we-do/code-of-practice-for-research/>)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
b) Have all contributions to knowledge been acknowledged?	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>
e) Does your research comply with all legal, ethical, and contractual requirements?	YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>


Candidate Statement:

I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)

Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):

Study 1 - SFEC 2018-127, Study 2 - SFEC 2019-066, Study 3 - SFEC 2019-090, Study 4 - SFEC 2020-090

If you have *not* submitted your work for ethical review, and/or you have answered 'No' to one or more of questions a) to e), please explain below why this is so:

Signed (PGRS):		Date: 20/12/2021
-----------------------	---	-------------------------

