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Abstract

Building on past studies that have found positive influence of minority member on team creativity, this research examined an underexplored yet crucial topic of a unique opinion holder's happy and anger emotions on team creativity. Using a collective information processing perspective, this study examined whether the expression of anger and happiness would be beneficial for team creativity by spurring team members to respond qualitatively differently to each other's ideas during the discussion. Additionally, this study examined whether the influence of a unique opinion holder's emotions on team creativity through information-processing pathways would depend on individual members' working memory capacities. Three hundred and ninety-six undergraduate students (M = 22.07 years, SD= 1.84) were randomly assigned to work with three to five members, including a confederate who expressed anger, happy or neutral emotions. They were asked to brainstorm ideas that could improve online learning for future semesters in Singapore. As compared with teams with a neutral unique opinion holder, teams with a happy unique opinion holder showed an improvement in their creativity by expanding the active associations within the semantic network of ideas across members (i.e., generative pathway). On the other hand, teams with an angry unique opinion holder elicited improved team creativity by deliberating on expressed ideas (i.e., elaborative pathway). These mediational pathways, however, did not depend on teams' levels of working memory capacity. Future applications with technological tools and implications of this research for organisations would be discussed.

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Contents

Chapter 1
Introduction

Organizations are faced with immense pressure to grow their creative capacities to survive and thrive in rapidly changing and challenging circumstances. Teams are the main drivers of most creative work in the organizations (De Dreu, 2002; Hoever, Zhou & van Knippenberg, 2018; Nijstad & De Dreu, 2012). Teams are ideal for creativity as teams can provide access to a larger and diverse pool of ideas through active communication and interaction among members (Curseu, Schalk & Wessel, 2008; De Dreu, 2002). As members critically consider and process these diverse ideas, those initial ideas can be further recombined with novel associations to form high quality creative solutions (De Dreu, 2002; Hoever, Zhou & van Knippenberg, 2018). While teams have the potential to be creative, teams can also easily struggle and be less creative when members rely on heuristic to simplify the processing of diverse ideas (Achtenhagen & Melin, 2003; Martin & Hewstone, 2003) or exhibit premature movement to consensus on few ideas for the sake of maintaining in-group harmony (Mucchi-Faina & Pagliaro, 2008; Martin, Gardikiotis & Hewstone, 2002).

A unique opinion holder has been examined in past studies as an effective trigger for enhanced team information-processing and thus higher team creativity (De Dreu, 2002; De Dreu & West, 2001; Schulz-Hardt, Mojzisch & Vogelgesang, 2008). A unique opinion holder is a special case of minority who actively voices his or her unique ideas to members and not someone who goes against the majority's view (Swaab, Phillips & Schaerer, 2016). These unique ideas, albeit not dissent, could also be viewed by other team members as surprising and thought-provoking (Nemeth, 1986). These ideas can easily thwart a team's desire for reaching quick consensus by directly threatening members' certainty on issues (Levine, 1989; Nemeth, 1986). Rather than readily accepting these unique ideas, team members are forced to think "out of the box" and utilize different task evaluative strategies that generate multiple

perspectives in order to better reject these ideas as to maintain group harmony (Nemeth, 1986; Nemeth & Roger, 1996; Swaab, Philips & Schaerer, 2016). As such, existing studies supported that the presence of unique opinion holders enhanced team information-processing strategies such as higher team divergent thinking (De Dreu & West, 2001), stimulated extensive information search to validate the alternative views (Martin & Hewstone, 2001a,b; Schulz-Hardt, Jochims & Frey, 2001), and achieved higher cognitive complexity (Curşeu, Schrujier, & Boroş, 2012), all of which positively contributed to team creativity.

Many studies on minority influence focused on the structural interventions, the motivational factors and individual characteristics to increase the unique opinion holder's influence in teams (Brodbeck, Kerschreiter, Mojzisch, & Schulz-Hardt, 2007, De Dreu, Nijstad & van Knippenberg, 2008; Meyers, Brashers & Hanner, 2000). For instance, the unique opinion holder's status as a newcomer was a useful structural intervention for changing ineffective procedures and increasing the new group's productivity for the idea-generative task (Choi & Thompson, 2005). Teams with minority dissent were more innovative when there was an intervention for members' participation in decision-making (De Dreu & West, 2001). Team motivational factors, such as high levels of epistemic motivation (De Dreu, Nijstad & van Knippenberg, 2008; Scholten, van Knippenberg, Nijstad, & De Dreu, 2007), high levels of prosocial motivation (Velden, Beersma, & De Dreu, 2007) and team learning goal orientation (Park & Deshon, 2010), were examined as key variables that predicted better processing of unique ideas for higher team performance. A considerable number of studies also found that a member's extraversion (De Dreu, de Vries, Franssen & Altink, 2000), bravery (Baron & Bellman, 2007), and confidence level (Park & Deshon, 2010) increased their willingness to express unique ideas or dissenting viewpoints to team members.

Although these studies enriched our understanding of a unique opinion holder's influence on team information-processing and outcomes, it is surprising that almost no study has focused on the implications of discrete emotions displayed by a unique opinion holder. The expression of specific emotions, such as happiness or anger, are ubiquitous in team creativity settings. For instance, during an idea-pitching session by members in the same marketing team, it is common for a member to express anger as he or she tries to repeatedly defend his or her unique ideas to make sure that other members could hear and thoroughly consider his or her ideas. Alternatively, a member could also express happiness for being provided with the opportunity to explore new research areas, thus exuding enthusiasm and happiness during his or her sharing of unique ideas with the team. Often, a member's happiness and anger emotions once elicited through conscious or unconscious displays of facial expression, postures and tone of voice could be hardly ignored by other team members (Barsade, 2000; Hatfield, Carpenter & Rapson, 2014; Van Kleef, Homan, Beersma & van Knippenberg, 2010). Rather, existing research in emotional contagion provided strong support of a member's emotions exerting powerful social influence for other members to feel the same emotions, and consequently, exerting impact on various team outcomes like cooperation and task conflict (Barsade, 2002), perception of leader's charisma and liking (Bono & Ilies, 2006; Johnson, 2008; Newcombe & Ashkanasy, 2002), and better team negotiation performance (Cheshin, Rafaeli & Bos, 2011). Given that it is a rising norm for teams to work on creative tasks, this research examines an underexplored and crucial topic of whether and how a unique opinion holder's happiness and anger could influence team creativity.

Team creativity refers to the creation of novel and useful solutions by teams (Hoever, Van Knippenberg, Van Ginkel, & Barkema, 2012; Pirola-Merlo & Mann, 2004). Using a collective information processing perspective, this study views team creativity as not merely

a random hodgepodge of unique ideas by team members but an outcome that is achieved by members who combine and advance upon each other's initial ideas (Hinsz, Tindale & Vollrath, 1997; Hoever et al., 2018). Therefore, depending on the quality of team information processing, teams working with unique opinion holders expressing happiness or anger could produce vastly different levels of creative outputs. Despite existing studies that found mixed and often conflicting findings of collective induction of positive or negative emotions on team creativity (Dugosh, Paulus, Roland, & Yang, 2000; Tsai, Chi, Grandey & Fung, 2012), I postulate that a unique opinion holder's happiness and anger can be both beneficial for team creativity by using two qualitatively distinct team information processing processes. Hence, this study highlights the unique benefits of emotions for team creativity by shaping the members' constructive responses that leverages on the each other's unique ideas to grow their capacities for higher creative outcomes.

Second, past studies found that the association between team emotions and team information-processing is usually dependent on some team-level characteristics (Tsai, Chi, Grandey & Fung, 2012; Van Kleef, Homan, Beersma & van Knippenberg, 2010). For instance, a team's collective emotional skills moderated the relationship between the team's positive affective tone and team performance (Collins, Jordan, Lawrence & Troth, 2016). Taking the collective information-processing perspective, this study views each member as an elemental cognitive agent whose attention, storage, and responding to information can be combined to form the team-level of cognitive processing (Hinsz et al., 1997). In this study, team working memory capacity, a newly conceptualized and operationalized team variable, is postulated to moderate the unique opinion holder's emotions on the dual information-processing routes. Specifically, a team composed of many members with high working memory capacities should contribute to a team's ability in keeping an active representation of members' ideas, task goals and strategies and retrieving relevant ideas while working in a

distracting environment. As such, these teams can easily navigate through distractions and harness the maximal advantage from the unique opinion holder's and other members' messages to achieve better information-processing. Taken together, this study contributes to an emergence perspective where a team's creative process is driven by the characteristics of team members and their unique responses to creative stimuli (Pillay, Park, Kim & Lee, 2020; Simonton, 2003).

In the following chapters, I will provide the theoretical background and hypotheses relevant to this research.

Chapter 2
Team emotions and Team creativity

For many decades, there has been growing interest in understanding and examining the influence of team affect on many emergent states, processes, and team creativity (George, 1996; Kelly & Barsade, 2001). Team affect is defined as the homogenous affective responses from members in a group (George, 1996; Barsade & Gibson, 1998). The term "affect" tends to be broadly used in existing studies, and several researchers proposed that "affect" could refer to more specific components of (1) dispositional or trait affect, (2) mood, and (3) emotions (Barsade & Gibson, 1998; Kelly & Barsade, 2001). Dispositional (trait) affect refers to an individual's pre-disposed nature to view many events that occur in their lives as mainly positive or negative (Lazarus, 1991, Staw, Bell, & Clausen, 1986). Emotions and moods are recognized as state affects that can either be strongly influenced by an individual's trait positive and negative affect or be significantly shaped by environmental triggering factors (Cheshin, Rafaeli, & Bos, 2011; Chi, Chung, & Tsai, 2011; Rhee, 2007; Sy, Côté & Saavedra, 2005). Although emotions and mood are treated as state affect, they differ significantly in terms of intensity, specificity, and duration (Kelly & Barsade, 2001). Emotions refer to a short-term intense feeling that is triggered by specific stimuli from the environment (Kelly & Barsade, 2001; Rhee, 2007). Emotions are easily recognised or felt by others, thus it can be clearly labelled as joy, anger, sadness, etc (Plutchik, 1980; Reber, 1985). On the contrary, mood tends to be of lower intensity, lasts for a longer duration and more diffuse which could develop without a specific cause (Barsade & Gibson, 2012). Mood are usually described in studies as generally positive or negative appraisals (George & Zhou, 2002; Kelly & Barsade, 2001). As compared to emotions, people do not necessarily realise their own mood experience and are much less aware of how mood influences their thinking or behavior (Kelly & Barsade, 2001).

Team emotions is not merely the aggregation of all members' emotional character but a collective phenomenon that emerges from the situational contexts or the interaction of individual members' emotions, cognition and behavior in teams (Kelly & Barsade, 2001; Rhee, 2007). Past studies recognised "Top-down" and "Bottom-up" as two key affective processes that are responsible for creating and sustaining emotions in teams (Barsade & Gibson, 1998; Kelly & Barsade, 2002). Because of these processes, teams could experience more extreme emotions than what individual members had previously possessed. "Top-down" processes focus on how emotions move from group-level downwards; specifically, how group or contextual factors would shape the group's emotional experience (Barsade & Gibson, 2012; Kelly & Barsade, 2001). On the other hand, "Bottom-up" processes examine how emotions move from individual-level upwards; which is to focus on the compositional effects of all group members' emotions to understand the group's emotions (Barsade & Gibson, 2012; Kelly & Barsade, 2001).

Top-down processes. "Top-down" processes refer to how external factors intensify or restrict the way which members experience emotions such that the team develops a homogenous emotional tone (Barsade & Gibson, 2012; Kelly & Barsade, 2001; Klein & Kozlowski, 2000). Specifically, members who work in identical organizations are likely to share local emotion norms and possess same emotional history which lead to a convergence in their emotional experience (Barsade & Gibson, 1998; Spoor & Kelly, 2004). For example, airline companies with a strong service-oriented culture may require their flight attendants to smile frequently to exude a positive demeanour when serving their customer during their shifts (Hochschild, 2012). Next, cohesive groups are likely to adopt emotion norms that drive conformity and uniformity in members' behaviour and emotions (Jackson, 1966; Kelly & Barsade, 2001). Also, groups are also likely to develop a shared emotional tone at temporal stages of a group's life span when they face specific socio-emotional considerations together

(Gersick, 1988; Knight, 2015). In Gersick's (1988) model of punctuated equilibrium, teams are likely to experience greater anxiety at the midpoint of their project due to a heightened sense of urgency to handle many issues to complete the task on time (Gersick, 1988). These issues may include a re-direction of attention from internal interaction problems to focus on designing new roles and activities and increased monitoring of remaining time which fostered better task completion (Chang, Bordia & Duck, 2003; Rhee, 2007).

Bottom-up processes. "Bottom-up" processes focus on the conscious and unconscious sharing of individual members' emotions to develop a homogenous team emotional tone (Barsade & Gibson, 1998). The unconscious spreading of emotions from individual-level upwards could occur in one of the three ways- (a) feeling of vicarious emotions, (b) behavioral entrainment, (c) emotional contagion (for a review, see Kelly & Barsade, 2001). From a social learning perspective, feelings of vicarious emotions occur when an individual experiences the same emotions as a model whom he or she has observed, such emotions then influenced his or her own behavior (Bandura, 1986). Behavioural entrainment refers to an iterative and nonconscious process of changing one's behaviour to sustain a synchronised interaction with people (Totterdell, Kelett, Teuchmann, & Briner, 1998). Emotional contagion could occur through two ways; first, primitive emotional contagion refers to the subconscious "mimicry" of another person's emotions such that two persons become similar in their affective states (Barsade, 2002; Barsade & Gibson, 2012; Elfenbein, 2014; Kelly & Barsade, 2001). Second, emotional contagion can also occur through a conscious and more deliberate process of social comparison (de Vries et al., 2018; Kelly & Barsade, 2001; Sullins, 1991). In other words, individuals would actively seek out other's emotions as informational cues to evaluate the appropriateness of their own emotions, and consequently, adjust their emotions to match with others thus construing a homogenous team emotional tone (cf. Festinger, 1954; de Vries et al., 2018). In sum, the "bottom-up" processes present a

crucial perspective of how individual members' affective antecedents can dynamically interact with other members' through explicit or implicit sharing process to produce group emotions.

Computation of team emotions composition. From the "bottom-up" perspective, team emotion is a higher-level construct that is composed of individual members' emotions as the primary unit. Team emotions are commonly conceptualized as (a) the mean level of emotions among members, and (b) the variance (i.e. dispersion) of emotions in the group. Many studies have examined more general kinds of collective emotions at the group level, such as group affective tone or group mood, wherein few research focused on specific and discrete emotions (Kelly & Barsade, 2002; Rhee, 2007). Therefore, my review would focus mainly on evaluating studies on discrete emotions that is consistent with my research theme, while some studies on affective tone and mood would also be introduced for the illustration of several key concepts.

Mean. It is common for studies to aggregate the individual member's self-reported emotions to its mean-level to conceptualize team emotions. Taking the mean approach, these studies view team emotions as a consistent and homogenous reactions that are shared by members in the same team (Cole, Walter, and Bruch, 2008; Pillay, Park, Kim & Lee, 2020). These studies typically used a direct consensus model where a within-group consensus of members' emotions is a necessary pre-requisite to operationalize the members' emotions (lower-level construct) as being functionally isomorphic to that of team emotions (higher-level construct; Chan, 1998; James, Demaree, & Wolf, 1984; Ostroff & Rothausen, 1997). A number of statistics, according to the recommendation of Bliese (2000) and Chan (1998), has to be met for a direct consensus model which includes R_{wg}, ICC(1) and ICC(2) values. First, R_{wg} indexed the extent of agreement within the group, and a value of .70 represents a sufficient homogeneity in emotions (i.e. members within a team are sufficiently similar in

their positive or negative affect), thus the members' emotions can be averaged to represent team emotions (Klein, Conn, Smith, & Sorra, 2001). Second, ICC(1) indicates how much group membership account for the variance in the target group (Bliese, 2000). According to the guidelines by LeBreton & Senter (2008), a small effect of group membership produces values of .01, and .10 to indicate a medium effect and .25 to indicate a large effect. Third, ICC(2) assesses reliability of group means where large values indicate larger variability between groups (Collins et al., 2016; Klein & Kozlowski, 2000).

Mean-level of group emotions influenced key group outcomes in both empirical and field settings. In the empirical setting, Pillay et al. (2020) operationalized team gratitude and team positive emotions as the mean level of members' self-reported gratitude, and the mean level of members' self-reported happiness, respectively. Teams in the gratitude condition achieved highly creative solutions through an elaborative process that refined members' initial ideas whereas teams in positive condition achieved more creative ideas as members engaged more in the process of shallow chatter (i.e. being enthusiastic and confidence in readily accepted any ideas; Pillay et al., (2020). Smith, Seger and Mackie (2007) found that group members who had high group identification tend to feel more positive emotions towards the group and expressed greater willingness to support ingroup and confront outgroup. In the field setting, Duffy and Shaw (2000) found that mean-level of members' envy (i.e. envy towards other in-group members) was positively associated with members' social loafing and negatively associated with cohesion and group self-efficacy. These three factors mediated the mean-level of members' envy and group performance (Duffy & Shaw, 2000). Also, Cole, Walter, and Bruch (2008) found that team's destructive behaviours predicted poorer work team performance indirectly by a team's negative affective tone defined as the mean-level of members' negative mood.

Dispersion. Team emotions are also increasingly examined as the heterogeneity of members' emotions in groups (Barsade, Ward, Tuner, & Sonnefeld, 2000; Magee & Tiedens, 2006). This conceptualization of team emotions is different from a direct consensus model where diversity in members' affects is treated as a meaningful conceptualization of team emotions. Specifically, the dispersion model of emotions focuses on the variation in members' emotions as an important aspect of members who work together in the same group (Harrison & Klein, 2007). For instance, the dispersion model becomes relevant for understanding team emotions in a context where one or few members experience persistent positive or negative emotions whereas other members are fairly average in their emotions. For studies that used a dispersion model, the within-group variance (or more precisely, standard deviation) in members' emotions could be indexed and operationalized as the team's emotions (Cole, Bedeian, Hirschfeld & Vogel, 2010; Roberson, Sturman & Simons, 2007).

Heterogeneity of group emotions also had significant influence on key group outcomes in both empirical and field settings. In the empirical setting, Magee and Tiedens (2006) manipulated heterogeneity in a group's emotional composition by showing photographs of happy and sad members within the same team to each participant while asking them to rate the teams in terms of their cohesiveness, common fate and responsibility over group outcomes. Specifically, participants who saw a team that consisted of more happy than sad members were more likely to view the group as being more responsible for group outcome, more cohesive and share more of a common fate (Magee & Tiedens, 2006). While Magee & Tiedens (2006) examined perceivers of a heterogenous group emotional experience, more studies focused on the influence of diverse affective states experienced by members on team outcomes. For instance, Emich (2014) manipulated heterogeneity in members' actual affective states by having members in the same team to listen to different kinds of music. Specifically, they found that groups with a least one member experiencing positive affect was

beneficial for better group decision-making quality as members exchanged more unique information and actively sought more information from others. In the field setting, Barsade, Ward, Tuner, & Sonnefeld (2000) examined the diversity of trait positive affect (PA) and trait negative affect (NA) in top management team on the firm's corporate financial performance. A team's diversity in trait positive affect predicted lower leader's participatory decision making and financial performance. Additionally, there was a significant interaction between the heterogeneity of members' trait PA and members' mean trait PA on team's emotional conflict and cooperation; that is, being affectively diverse when teams were low in mean trait PA predicted higher levels of task and emotional conflict (Barsade et al., 2000).

The understanding of "Top-down" and "Bottom-up" affective processes and the compositional model of members' emotions provide the contextual background for this research. I argue that "Bottom-up" affective processes would serve as a better explanation than "Top-down" affective processes to elucidate why and how a unique opinion holder's emotion influence team creativity. The observation of a member's emotions can powerfully impact other members' emotions to feel similar emotions through either an affective or an inferential process (Van Kleef et al., 2004; 2009), thus the aggregation of all members' emotional character is an appropriate conceptualization of the team emotional tone. Therefore, in the next two chapters, I will review the literature on "Bottom-up" affective process, especially in terms of emotional contagion, on team processes. Given the current lack of studies that examined the emotional contagion-team creativity link, I review studies that examine the collective induction of group emotions on team creativity.

Chapter 3
Team emotion contagion and team outcomes

Recent research has increasingly examined the spreading of emotions from a member to other members in a team (i.e. a bottom-up process). That is, to explain why and how observing discrete emotions of a target member can elicit similar emotions in a team (Hatfield, Cacioppo, & Rapson, 1992). Emotional contagion refers to "a process in which a person or group influences the emotions or behaviour of another person or group through the conscious or unconscious induction of emotion states and behavioural attitudes" (Schoenewolf, 1990, p.50; Barsade, 2002). Emotional contagion is said to have occurred when other members "caught" the emotions from the target member, and members become affectively similar (Barsade, 2002). The convergence of members' emotions could, in turn, powerfully shape their own attitudes, cognitions and behaviors (Lazarus, 1991) across a wide variety of social situations from dyadic negotiation-settings (Van Kleef, De Dreu & Manstead, 2004) to leader-employee relations (Sy et al., 2005) as well as group cooperation (Barsade, 2002).

Emotional contagion can occur in two ways. First, primitive emotional contagion refers to a situation where individuals unconsciously and automatically mimic other's emotional expression, and this physiological feedback from their facial muscles (i.e. facial efference) could influence the emotions of the observer to be the same as the target (Adelmann & Zajonc, 1989). For instance, Pugh (2001) observed the occurrence of positive emotional contagion between bank tellers and their customers. As bank tellers displayed positive affect by making more eye contacts and smiling more during their transactions with the customers, customers also reciprocated with more positive affect, which led them to evaluate the quality of customer service favourably (Pugh, 2001). Second, social comparison process can also bring about emotional contagion. People tend to compare other's emotions

with their own emotions to understand how they should be feeling, and constantly re-adjust and fine-tune their emotions to match other's emotions. As a result of this social comparison process, two or more members within the same team become more affectively similar (de Vries et al., 2018; Elfenbein, 2014; Sullins, 1991). In sum, sharing of emotions among members can rely on either an automatic and subconscious process (i.e. primitive emotional contagion) that people have little or a more conscious and deliberate cognitive process (i.e. social comparison).

Many of the emotional contagion studies were conducted in the context of leader-member exchange. In these studies, positive (negative) leaders contagiously influenced team members with positive (negative) emotions, which could result in either better or poorer outcomes for the team (for a review, see Barsade, Coutifaris & Pillemer, 2018). In general, happy emotional contagion from leader to members was associated with positive outcomes, such as being more cooperative (Van Kleef et al., 2009), having greater perception of the leader's liking and charisma (Johnson, 2008), leader's perceived effectiveness (Bono & Ilies, 2006), and an increased followers' creative performance over their analytical performance (Visser, van Knippenberg, van Kleef and Wisse, 2013). On the other hand, a leader's display of negative emotions on followers' outcomes tends to be mixed. Some studies found that an angry leader evokes significantly more negative emotions (i.e. higher nervousness and lower relaxation) among followers as compared to a neutral leader, and their angry leader was also perceived as being less effective (Lewis, 2000). However, followers may also interpret a leader's negative mood as an indication of suboptimal performance (Fitness, 2000), which leads them to put in greater task effort (Sy et al., 2005). A leader's anger expression could also enhance the followers' perception of the leader's competence and status (Tiedens, 2001). Similarly, other studies supported anger expression as a powerful persuasive tool where a leader would intentionally express anger rather than neutral or happy emotions to elicit

desired behaviours out of the followers (van Kleef, Homan, Beersma, van Knippenberg, van Knippenberg & Damen, 2009).

Across many leader-followers' studies, the intensity of negative affective display was assumed or held constant at a moderate level (van Kleef & De Dreu, 2010; van Kleef et al., 2009). Even though strong and intense happy emotions were found to increase followers' perception of a leader's charisma (Cherulink, Donley, Wiewel & Miller, 2001) and a leader's effectiveness (Barsade et al., 2000; Joseph et al., 2015), but highly intense positive or negative emotions could also create worse team outcomes. A reason is that high intensity of emotional displays tends to violate the "emotional rule" for the team context, which is largely assumed to be moderately positive, thus triggering a higher perceived inappropriateness of emotions from the followers (Ekman, 1993; Shields, 2005; Van Kleef et al., 2009). Furthermore, the dual-threshold model argued that intense anger are likely to backfire and elicit negative responses from team members as intense anger is highly inappropriate for the situation (Geddes & Callister, 2007). A recent study by Staw, DeCelles & de Goey (2019) corroborated on existing studies on that moderate level of affect being the most effective for teams. They found a curvilinear relationship between the intensity of a leader's negative affect and members' hardwork; that is, a leader's moderate negative affect prompted followers to put in greater efforts towards the task, but this effect disappeared at both weak and high intensity level of the leader's negative affect. Therefore, the examination of the leader's intensity of emotional expression presents a crucial and nuanced understanding towards the leader-follower's emotions and group outcomes.

Even though the leader-follower relationship is a crucial aspect of team functioning, the findings cannot be assumed for teams with members of equal status. Leaders can be viewed as high power members who often serve as models to others regarding the appropriateness of certain behaviour (i.e. setting the tone for the group), therefore, their

emotions should have a greater influence on group dynamics and outcomes (Berdahl & Martorana, 2006; Fitness, 2000; Kelly & Barsade, 2002). Similarly, past study also supported that people pay more attention to those in power in an effort to predict and control their own outcomes (Fiske & Berdahl, 2007). To some extent, leader's emotions may be classified as an affective context which is beneficial in shaping the group's response to various situations and challenges, thus enriching the group's coping capability (Barsade & Gibson, 2012). As compared to an extensive number of studies on leader-follower relationship on emotional contagion, only scant research has been conducted on group emotions or affect in specific team contexts, such as decision-making (Barsade, 2002; Emich, 2014), team coordination and effort (Bartel & Saavedra, 2000), but not in team creativity. In these existing studies with equal status members, an individual member's positive affect led to convergence in the members' self-reported positive affect, which bring about greater levels coordination and effort (Bartel & Saavedra, 2000), improved team performance (Emich, 2014), and decreased conflict and increased cooperation with each other (Barsade, 2002; Totterdell et al., 1998). Even when the mode of communication was shifted online (i.e. virtual teams), Cheshin, Rafaeli & Bos (2011) found that emotional contagion also occurred through the exchange of texts; interaction with a flexible (resolute) confederate increased members' reported feelings of happiness (anger), and in turn, generated more positive (negative) outcomes in negotiation of virtual shapes to build their own desired patterns.

The existing findings elucidate that an individual's emotions can powerfully and dynamically influence that of other members' emotions and behaviour across different contexts. This study adds value to the emotional contagion literature by examining how an unique opinion holder's emotions, an equal status members, would influence team creativity.

Chapter 4

Team emotions and Team Creativity

Existing research found that positive emotions can be beneficial for team creativity in many ways. First, Fredrickson's (2001, 2003) broaden-and-build perspective associates positive emotions with more divergent thinking and broadening of members' momentary thought-repertoire (Fredrickson & Branigan, 2005; Rhee, 2007), which, in turn, expands the range of ideas accessible to the members (Kuhbandner, Lichtenfeld & Pekrun, 2011). Supporting this notion, team studies on collective positive emotions found that these teams were more likely to use information flexibly, shared divergent insights with their team and stimulated each other to generate more ideas that span many categories (Grawitch, Munz, Elliott & Mathis, 2003; Rhee, 2007). Similarly, these positive teams could develop higher information-processing efficiency in linking relevant information together and actively generate new options during discussion (George & King, 2007). Second, positive emotions can also play an affiliative function for building an enduring social resource among members. Past studies found that feelings of happiness tend to increase one's trust towards others (e.g., Walter & Bruch, 2008), being more collaborative and enthusiastic about new ideas, take greater risks and feel less inhibited in exploring new things (Amabile, 1998; Sunstein & Hastie, 2015). As such, happy teams should confer greater psychological safety for all members to actively share and discuss many unique ideas to increase team creativity. Thirdly, according to mood-as-input model, happy mood could also indicate a safe and innocuous task environment that would increase members' willingness to adapt and engage in novel, exploratory and varied approaches that benefit team creativity (George & Zhou, 2002; Martin & Stoner, 1996).

However, positive emotions can also be detrimental for team creativity. Recent studies found that positive team affective tone can constrain creativity when teams have high trust towards each other. Members might feel refrained from vigorously debating task opinions or voicing their disagreement with existing ideas to preserve harmony in the team (Tsai, Chi, Grandey, & Fung, 2011). In such cases, the experience of positivity locked members into a single fixed perspective, rather than making them more divergent in their thinking, thus hindered their creative performance (Tsai et al., 2011). Additionally, happy teams can also induce members' feelings of complacency about the task. These teams could severely underestimate task demands and put in less effort into designing creative solutions (e.g. Schwarz & Clore, 2003; Van Kleef et al., 2009). Additionally, positive emotions are likely to increase the team's engagement in consensus-seeking tendencies and shallow processing of information (Forgas, 1992; Schwarz & Clore, 2003). As pointed out by a book by Sunstein & Hastie (2015), positive emotional groups may engage in excessive "happy" talk, wherein their expression of enthusiasm and confidence reduced a thorough consideration of unique perspectives by group members.

The study of specific and discrete positive emotions, such as gratitude, further clarified the creativity-boosting effect of positive emotions on team creativity (Pillay, Park, Kim & Lee, 2020). Gratitude, which refers to valuing and being aware of the benefits received and motivating one's intention to reciprocate (Fredrickson, 2004; McCullough, Kilpatrick, Emmons & Larsen., 2001), was found to drive teams to higher creativity through greater team elaboration. Unlike the generally positive teams, Pillay et al. (2020) found that members in the team gratitude condition were less likely to engage in shallow chatter with members, but instead focus their effort on generating quality creative solutions through deliberating, advancing, and integrating unique perspectives expressed during a discussion (Pillay et al., 2020). This outcome was different from a generally positive team, wherein

members were enthusiastic and confident of their ideas generated, in turn, quickly agreed to many proposed ideas which led to the generation of a larger quantity but not quality of creative ideas (Pillay et al., 2020).

Negative emotions and team creativity

Negative emotions can be adaptive for teams by demarcating group boundaries and by warning members of potential danger from outside entities (Fisher & Manstead, 2008). First, according to mood-as-input model, negative mood can also be interpreted by members as a sense of threat and danger (Miron-Spektor, Efrat-Triester, Rafaeli & Schwarz- Cohen, 2011). In the teams, members are likely to coordinate their responses and direct their attention towards resolving immediate issues, in turn, to quickly remedy the situation and avert further risks (Cole, Walter & Bruch, 2008). In team creativity studies, members of these negative mood teams experienced a narrowed thought-action repertoire that was aligned with a systematic and detail-oriented information processing (De Dreu, Baas & Nijstad, 2008; Van Knippenberg, Kooji-de Bode & Van Ginkel, 2010). More specifically, teams with negative affect achieved higher creativity through a more elaborative processing of scrutinising task problems, discussing, refining and advancing upon each other's initial ideas (De Dreu et al., 2018; Klep, Wisse, & Der Flier, 2011; Van Knippenberg, Kooji-de Bode & Van Ginkel, 2010). Second, teams are also likely to view negative emotions as an indication that their current efforts are insufficient, or the existing situation is sufficiently problematic (Rees et al., 2019; Van Kleef et al., 2009). This interpretation could, in turn, trigger a team's regulatory effort to minimize the gap between the present state and their desired state; that is, teams may push themselves to work harder (i.e. greater persistence) to improve better solutions (Carver & Scheier, 1998; George and Zhou, 2002, 2007; Martin & Stoner, 1996). For individuals, the experience of negative mood- particularly activating mood (i.e. anger) and not deactivating

mood (i.e. sad)- led to higher creativity through individuals' increased perseverance within categories (i.e. more number of ideas) and spending longer time on the task (De Dreu, Baas & Nijstad, 2008). The results were also similar in teams; Jones and Kelly (2009) found that teams in negative mood were more creative than individuals in negative mood in a slogan generation task. Additionally, the influence of the analysis level (i.e. individual vs. group) on creativity was mediated by groups persisting more than individuals on the task; that is to spend more time on improving their ideas (Jones & Kelly, 2009).

Negative emotions can also be detrimental for team creativity. Recent evidence suggests that the collective experience of negative emotions could lead teams to feel constrained and controlled by negative affective states that they cannot extract themselves from (Grawitch, Munz, & Kramer, 2003). In this case, members are likely to prioritize the fixing of their own negative mood rather than focusing on achieving creative task goals with their members (Grawitch, Munz & Kramer, 2003). Second, negative emotions can also manifest themselves in terms of showing destructive behaviours towards other members, such as showing hostility towards others, engaging in deviant behavior (Aquino, Lewis & Bradfield, 1999), making threats (Yang & Mossholder, 2004), shouting at others, etc (Morris & Keltner, 2000). These destructive behaviors within negative teams can decrease social integration that distracts the team from completing their tasks (Felps, Mitchell & Byington, 2006; Knight & Eisenkraft, 2015). Last but not least, a threat-rigidity hypothesis postulates negative emotions experienced by team as an adverse event that evokes anxiety in members. It becomes less surprising for anxious team members to automatically experience a narrow and focused attention span and breadth in cognitive processing (Gladstein & Reilly, 1985; Staw, Sandelands, & Dutton, 1981), as a result, these teams are usually less effective in processing peripheral cues or divergent information while increased their reliance on formalized information (Staw et al., 1981). Therefore, teams with negative emotions tend to

score badly on creativity tasks, such as alternate uses test, which call for the team's attention to divergent information.

Given these mixed and conflicting reviews of group emotions and team creativity, I postulate that these findings can be reconciled by systematically examine both positive and negative emotions in the same study and to further elucidate the information processing pathways harnessed by the specific emotions. From the collective information processing, teams achieve good outcomes they actively communicate and interact with each other to collectively interpret the tasks, and critically process all members' information. Therefore, I posit that teams with equal creative calibre working with a happy or angry member can achieve highly creative solutions by leveraging on a team generative pathway or a team elaborative pathway. By doing so, this study provides a nuanced perspective on the emotion-creativity link at the team-level, which also builds upon past theoretical anchor of a dual pathway model postulated by De Dreu et al. (2008) and Nijstad et al. (2010). In their dual pathway model, they posit that individual creativity may be attained by (1) positive mood increased individual's cognitive flexibility by switching rapidly across different categories of ideas and (2) negative mood enhanced individual's cognitive persistence demonstrated by members who adopted a systematic search for information and spent more time on the task. Taken together, this study highlights the unique benefits of emotions for team creativity by shaping the members' constructive responses that leverages on the each other's unique ideas to grow their capacities for higher creative outcomes.

Chapter 5
Individual and Team working memory capacity

Working memory capacity refers to the capacity of actively maintaining and retrieving goal related information without being distracted by irrelevant information for a brief time (Unsworth & Engle, 2007; Unsworth et al., 2009). Working memory allows individuals to remember and keep track of many changes within an important task even under interference, thus facilitating these actively held information to be manipulated at a later stage (Engle, 2002; Unsworth et al., 2009). Working memory capacity, however, is not the same as short-term memory which refers to the amount of information that individual can retain for a brief amount of time (Engle, 2002). Short-term memory can be easily assessed with a digit span task or corgi block which an individual would only need to rehearse and recall items in a pre-defined sequence (Unsworth & Engle, 2007). However, working memory capacity is more complex than short-term memory because of the interference component, which is examined with complex working memory span measures (Unsworth & Engle, 2007). For instance, the operation-span task requires individuals to solve math problems (i.e. a distractor) while remembering a list of unrelated words in the correct order (Unsworth et al., 2009). High working memory capacity individuals would perform better than low working memory individuals as they have better ability in controlling their attention from distraction to maintain more items being active in their mind, and not necessarily because they had a larger memory store (Shipstead et al., 2015). When the interference component was removed in dichotic listening task, Colflesh and Conway (2007) found that lower working memory capacity individuals did not perform significantly differently from those with higher working memory capacity.

Working memory capacity is also crucial for creative tasks that assess either convergent or divergent thinking. First, working memory benefits creativity because it

prevents unwanted distraction and helps individual to stay focused on the task (Gilhooly et al., 2007). Working memory capacity contributes to divergent thinking in creativity tasks by resisting the interference from common ideas to facilitate the generation of most original ideas (Gilhooly et al., 2007; Kane, Bleckley, Conway, & Engle, 2001; Silvia, 2008a, b). Additionally, working memory capacity also confers individuals with greater ability to switch between different categories of ideas thus achieving higher performance on divergent creative tasks, like alternative uses tasks (e.g. Benedek et al., 2012; Gilholy et al, 2007). Even for creative tasks that relied on convergent thinking, like Remotes Associates Test (RAT), working memory capacity is crucial for individuals to "think-out-of-the-box" and break free from ineffective strategies and approaches as to focus only on those feasible approaches (Lin & Lien, 2013). Existing research on working memory capacity and creativity found evidence that separately supported the positive benefits of working memory on divergent thinking, convergent thinking and associative fluency (Lin & Lien, 2013). Lee and Therriault (2013) is one of few studies that examined the association between working memory capacity and three creative thinking process. Their findings suggested that working memory capacity could indirectly predict one's divergent and convergent performance on creative tasks through one's intelligence and associative fluency (Lee & Therriault, 2013).

Extending the association between working memory capacity and individual creative task performance, this current study conceptualized and operationalized team level of working memory capacity to further examine its effect on team creativity. In this study, I defined team working memory capacity as the average of working memory capacity among members. The team would possess higher levels of working memory capacity as more members are high in working memory capacity. This compositional approach is one of the common ways of conceptualizing team level constructs in team studies (Bell, 2007). Specifically, the existing conceptualization is appropriate as members' working memory

capacities is viewed as an ability construct and that the team creativity task is additive in nature; that is the creative output is determined by all members' collaborative efforts in generating and processing ideas, and not just the effort by a single member (Bell, 2007). A team with higher working memory would be able to prevent unwanted and irrelevant distraction to better focus members' attention on maintaining an active representation of all discussed ideas, task interpretation and procedural strategies in their mind, and also facilitate the retrieval the relevant information from the long-term memory of each member. As this is the first study that examines team working memory capacity, I utilize top-down and bottom-up perspective to elucidate how this construct can be formulated through social interaction. Using a "top-down" perspective, a team can develop team working memory due to external factors that amplify or constraint how teams execute and keep track of their progress on the task. For instance, organizations may require leaders and managers to request for more frequent reviews and updates of the team's progress in terms of new and revised approach to their task at the start of their weekly meeting. By incorporating this structure in their meetings, teams are required to actively maintain and retrieve task related information that are relevant to their most recent approach, and prevent members from irrelevant distraction in term of proactive interference (i.e. past approaches that was relevant and became irrelevant) or mind-wandering (i.e. distractions that are not task-relevant at all). This structural approach would help teams grow their working memory capacities for effective performance.

Using a "bottom-up" perspective, when a team comprises of one or few members with higher working memory capacity, these members can easily and actively hold and retrieve goal-related information while he/she prevents any distractions from the task. As teams do not possess a physical memory storage, unlike individuals, teams hold information related to the task and procedural strategies in shared mental models (Harris, Paterson & Kemp, 2008; Hinsz et al., 1997; Hirst & Manier, 2008; Littlepage & Karau, 1997). Additionally, the

specific information unique to members' expertise is held in members' own transactive system (Wegner, 1987). Team members need to actively discuss their perspectives and ideas related to the task as to move in a synchronised manner in a step-by-step fashion. As such, team members with high working memory can function as a coordinator who make sure that (a) all members actively hold the task goals in their mind, and (b) consistently think of how to apply their relevant expertise to the team. First, it is likely that these "coordinators" will seek clarification and checks by asking questions "I think we have previously agreed to pursue strategy X instead of Y, am I right?" or to set directions and interpretations for the team "I think [event] is more important for young and old and we should generate ideas accordingly." These forms of constant probing and setting of direction help prevent distraction and help all members to stay focused on the task. Second, members with higher working memory can also play the advocate role by directing questions at other members to seek knowledge of that member's expertise to the task, thus facilitating the achievement of team goals. In sum, teams with members of high working memory capacity are fundamental to coordinate members' actions that target at the task and prevents distraction, thus escalating into higher team creative performance.

Chapter 6
Main hypotheses

Team creativity refers to the creation of solutions that are highly original and practical by a group of individuals (Hoever, van Knippenberg, Ginkel & Barkema, 2012; Rietzschel, Nijstad & Stroebe, 2006; Shin & Zhou, 2007). Using a collective information processing perspective, I argue that team creativity is not a random hodgepodge or collection of creative ideas generated by an individual member. Rather, team creativity is an outcome that is achieved through team discussion where members adopt processes that allow them to collectively consider, further advance on, and integrate each other ideas (Hoever et al., 2018; Pillay et al., 2020). In this study, I postulate team generative processing and team information elaboration as two distinct and separate information-processing processes leading to higher team creativity.

Team generative processing refers to a process of collaborative improvisation of novel ideas through cognitive stimulation that spread the activations across fellow members' semantic networks (Hoever et al., 2018). Each member's conceptual knowledge is retained in their long-term memory in the form of a semantic network of mutually interconnected nodes, and these concepts can be retrieved and recalled once activated (Gruzka & Necka, 2002). Teams engaged in generative processing during discussion may experience many serendipitous – "Aha!"–moments whenever members see relatedness in concepts shared by others and those in their own semantic network (Dugosh et al., 2000; Cronin & Loewenstein, 2018). Therefore, team generative processing denotes a stochastic advantage of team discussion — the more team members produce the collective association of ideas, the more it is likely for them to access remotely related ideas and concepts (Simonton, 2003). As the range of ideas grows, teams are increasingly likely to discover highly creative ideas (Kurtzberg & Amabile, 2001). Unlike team idea elaboration which focuses on the quality of

creative solutions that teams generate, team generative processing positively impacts the number of ideas that teams develop. Thus, generative processing allows teams to enjoy the benefits of a highly creative solution by exposing them to diverse sets of ideas. When team generative processing is low, members are unlikely to utilize other members' expressed ideas to trigger more divergent outputs. Therefore, these teams are less likely to lead the discussion in an off-tangent manner and collectively attain less creative ideas.

Hypothesis1a: Team generative processing should be positively associated with team creativity.

Team idea elaboration is a process that occurs when ideas and perspectives are continuously improved by other team members through active discussion and feedback (Hoever et al., 2012; Hoever et al., 2018). Through active idea elaboration, members' expressed ideas trigger off careful consideration by other teammates, which becomes further refined, deliberated, and integrated with different ideas (De Dreu et al., 2011). As the process of team idea elaboration continues in the discussion, members' initially independent and unique perspectives become increasingly evaluated and jointed, and teams reap the benefits of cross-fertilization, thereby creating highly creative solutions that are highly insightful and comprehensive (Harvey, 2013). Through active idea elaboration, team members not only deepen their understanding of different ideas but also build upon them in a creative fashion (Scott, Lonergan & Mumford, 2005). When team idea elaboration is low, team members' unique and potentially divergent perspectives remain unevaluated and disjointed. Consequently, the team fails to reap the benefits of cross-fertilization afforded by discussion, resulting in solutions that are simplistic or incoherent.

Hypothesis1b: Team information elaboration should be positively associated with team creativity.

Emotions refer to a specific, short-term and an intense feeling that arises from one's appraisal of the situation (Van Kleef et al., 2009). According to Emotions and Social Information Model (EASI) theory, a target's emotions can provide crucial information to observers on how the target perceives or thinks of the situation (van Kleef, De Dreu & Manstead, 2004). Depending on the information that the observer had inferred from the target's emotions, the observer would change his/her judgement and behaviors accordingly (van Kleef et al, 2004).

Happiness, for instance, is a form of positive emotion that occurs due to goal fulfilment or a contentment with present task progress (Lazarus, 1991). When happy emotion is expressed through the facial expression, tone or body postures of the unique opinion holder, members in the same team can interpret positive emotion as a sign that the task environment is innocuous and benign (George & Zhou, 2002; 2007). As a result, these teams may not feel encouraged to change their current behaviors or devote greater task efforts towards identifying and resolving problems in the task (Rees et al., 2019). Instead, interacting with a happy member who expresses unique ideas should lead teams to greater divergent thinking and the adoption of more global and heuristic cognitive processing that aids in the flexible exploration of different alternatives and options (De Dreu, Baas, & Nijstad, 2008; Fredrickson, 2001). This line of thought is consistent with Sunstein and Hastie (2015)'s observation of how happy teams were more likely to see things as going well and not worrying, in which their confidence and enthusiasm spurred more happy talk (talking a lot, sharing many ideas, etc) among members. Additionally, members may also view a happy unique opinion holder as trustworthy and cooperative where they would hardly question the member's or each other's intention or priorities (Rhee, 2007). Rather, these happy emotions facilitate the building of enduring social resources, such as collaboration and helping among

members, wherein members feel encouraged and safe to share different unique ideas with each other (Fredrickson, 2001; 2003).

Therefore, as compared to teams that work with a neutral unique opinion holder, teams who work with a happy unique opinion holder should achieve higher team creativity through the process of team generative processing. Happy teams would be more adept to carry less fixed mental categories such that more and multiple linkages can be drawn between disparate and distinct concepts (Fredrickson, 2001; 2003; Hoever et al., 2018). Therefore, a broader and more diverse associative network of ideas is being stimulated in these teams (Hoever et al., 2018). In other words, when tasked to generate ideas to improve online learning, a member who listened to the word "technology", this word may also simultaneously activate other associated concepts, such as "online experiential classes", "interactive element" and "social media" that have been previously stored as interconnected nodes located along many different paths that traverse in all directions in the member's semantic network. By continuously rolling out this collective train of thoughts through intersections of team members' semantic networks, teams get to develop interesting ideas. This associative nature of a cognitive system has been widely argued as a viable way for individuals to generate creative outputs, and I posit that a happy unique opinion holder would similarly activate the associative cognitive system among members in the team, which, in turn, positively influence the way that teams produce creative ideas during a discussion (Hoever et al., 2018; Simonton, 2003).

Hypothesis2a: As compared to teams with a neutral unique opinion holder, teams with a happy unique opinion holder who expresses unique perspectives should achieve higher team creativity through greater team generative processing.

Anger is a negative emotion that occurs due to someone's goals are blocked or experience a sense of discontent with the current situation (Rees et al., 2019). It is also an

approach emotion associated with an individual's need for changes in the situation (Van Kleef et al., 2009). According to the EASI model (Van Kleef et al., 2004), team members may infer the anger of a unique opinion holder as an indication of a problematic situation that has to be quickly resolved. As a consequence, observing someone's anger can be adaptive to help members in narrowing their scope of attention to exclude irrelevant issues and only focusing on relevant issues (Derryberry & Tucker, 1994), as well as to seek more information to quickly identify the problem and make corrective actions. For instance, Rees et al. (2009) found that a negotiation with an angry negotiator spurred their counterparts to demonstrate greater information search and more value-creation in the negotiation outcomes. On the other hand, members may also feel threat and fear from viewing the unique opinion holder's anger (Miron-Spektor et al., 2018). These negative feelings could easily drive teams to prioritize safety, avert danger, and in turn, enhances rigid and dichotomized thinking (Cole, Walter & Bruch, 2018). As such, teams could easily leverage on their narrowed attention span for a thorough information search and increased scrutiny on all members' expressed ideas thus maximizing the quality of solutions (De Dreu et al., 2008; Friedman and Förster, 2005). As compared to teams interacting with happy unique opinion holder, teams with an angry unique opinion holder are, therefore, only have limited attention to only highly accessible mental representations, leading these teams to utilize a different information processing route.

Therefore, as compared to teams that interact with a neutral unique opinion holder, I postulate that teams that interact with an angry unique holder would endorse more extensive and thorough processing of information, and in which, members' expressed ideas trigger off careful consideration by other teammates, which becomes further refined, deliberated and integrated with different ideas (De Dreu, Nijstad, Bechtoldt & Baas, 2011). In other words, unique ideas expressed by members who feel anger may propel their teams to engage in deep-level information processing that considers multiple unique ideas, rather than surface-

level information processing that is heuristic-driven and consensus- seeking (Nemeth & Wachtler, 1983). Through such active team idea elaboration, teams reap the benefits of cross-fertilization of members' initially independent and unique perspectives, thus creating highly insightful creative solutions (Harvey, 2013). For teams that did not engage sufficiently in team information elaboration, individual members' ideas would only be minimally acknowledged and not further cultivated with other members' feedback and suggestion. As a consequence, the team's collective output would be a rudimentary summary of the initial ideas that members brought to the teams.

Hypothesis2b: As compared to teams with a neutral unique opinion holder, teams with an angry unique opinion holder who expresses unique perspectives should achieve higher team creativity through higher team information elaboration.

Moderating role of team working memory

Previous studies suggest that observing another person's emotions may not create the same outcomes for teams. Existing studies have examined several factors that moderated the appraisal of discrete emotions on information-processing by individuals and teams. For instance, Hillebrant & Barclay (2017) found that individuals' low need for cognitive closure motivated individuals to deeply process another person's emotions even when there was a lack of a clear emotion target. Van Kleef, Anastasopoulou, and Nijstad (2010) found that teams with high levels of epistemic motivation in information processing inferred their leader's anger as being unsatisfied with their performance, which spurred members to put in more effort towards enhancing their performance.

In this study, I propose that team working memory capacity would influence the extent to which teams consider and process the unique ideas expressed by the happy or angry member. Teams with higher working memory capacity are likely to better harness the

synergistic benefits from a happy unique opinion holder's unique expression to achieve greater collective improvisation of novel ideas through members' semantic networks, thus proving a greater level of serendipities- "Aha!" moments during group discussion (Dugosh et al., 2000; Cronin & Loewenstein, 2018). First, when teams have higher working memory, they are less likely to be distracted by irrelevant ideas and could hold more ideas and approaches discussed by the team in an active state in members' mind. By holding these items in an active state, multiple ideas can be activated and used to retrieve many more remotely linked concepts in their own semantic network of ideas, and across that of different members' semantic networks (Gruszka & Necka, 2002; Yu, Peng, Peng, Zheng & Liu, 2016). As such, happy teams are likely to achieve a continuous cycle of collective improvisation of ideas where they are adept at using each other's ideas as trigger for even much more innovative insights. Additionally, teams with higher working memory capacity could easily overcome any fixation on common and ordinary ideas to focus on retrieving more original ideas and recombining these ideas using novel linkages (Gilhooly et al., 2007; Kane et al., 2001). In contrast, teams with lower memory capacity are easily swayed and distracted by irrelevant cues and they may face challenges in remembering members' expressed ideas and task approaches. As a result, very few relevant ideas could work as a trigger of remotely linked concepts within and across members' semantic network of ideas (Hoever et al., 2018; Simonton, 2003). As the discussion progresses, team members may arrive at a linear stream of similar ideas that could be represented as closely associated nodes in most members' semantic network. Thus, these teams are less likely to receive the maximal advantage of working with a happy unique opinion holder on their own team generative processing.

Hypothesis 3a: There is a moderating effect of team working memory capacity on unique holder's happiness on team generative processing. Teams with high working memory

capacity will experience higher team generative processing when working with a happy unique opinion holder.

Teams with a higher level of team working memory capacity could also better harness the unique idea expression by the angry unique opinion holder to achieve higher team idea elaboration. Teams with high level of working memory capacity are less likely to be distracted by the unique opinion holder's anger expression but to focus their attention in relentlessly probing him or her with more questions to clarify his or her perceptions of task and strategies, which, in turn, facilitates a common and mutual understanding of the task among members. Therefore, these teams with high working memory capacity are more likely to uncover the possibility of an unresolved problems that they might have previously missed out. Armed with better understanding of the task, teams are more likely to maintain an active representation of both effective strategies and discussed ideas by members, and to prevent any distraction from previous strategies that failed. Therefore, they are better positioned to provide useful opinions to elaborate and advance upon each other's ideas (Rees et al., 2019; Van Knippenberg, Kooij-de Bode & Van Ginkel, 2010).

Additionally, teams with high level of working memory are likely to suppress any tendency for quick agreement given their tendency to cooperate with an angry member. These members would put in greater amount of effort at deliberating, elaborating, and advancing on each member's initial inputs, thus making those ideas much more refined and of greater depth to address the problem (Hoever et al., 2012; 2018; Van Knippenberg, Kooij-de Bode & Van Ginkel, 2010). On the other hand, teams with low team working memory may be less capable to suppress their tendency for consensus seeking, such that team members may be easily swayed by the angry member to feel affectively angry. In a way, members might not work well together with the angry member (Van Kleef et al., 2014), such

that they quickly commit to few solutions without sufficient deliberation and advancement of expressed ideas.

Hypothesis 3b: There is a moderating effect of team working memory capacity on unique holder's anger on team information elaboration. Teams with high working memory capacity will experience higher team information elaboration when working with an angry unique opinion holder.

Chapter 7
Pilot study

Past studies have utilized confederates as an effective and an appropriate means of transmitting emotions during discussion that were conducted in face-to-face settings (Barsade, 2002, Visser et al., 2013), but almost no study has replicated this setting for a creativity task performed on a virtual setting. Therefore, the pilot study was set up to examine the effectiveness of the verbal content (i.e. unique idea expression) and the non-verbal emotional content (i.e. facial expression, tone, and behavioral postures) in conveying happiness, anger and neutral. For the verbal aspect, the confederates followed closely to the unique idea expressions written in the script (Appendix E), as well as for the rationale statement said at the start of all discussion "*I think schools, in general, have already put in some steps to prepare their students for online learning. I think there is so much more we should do with online learning, especially with Covid right now.*" Past studies found that inappropriate emotional displays that violate people's expectations tend to evoke negative emotions in perceivers (Bucy, 2000). As such, this study utilized these statements to lend appropriateness to manipulated emotional expression in the specific discussion context of online learning. On the other hand, the non-verbal emotional content was highly varied across all three conditions. Following past studies, the confederate was told to speak the same unique ideas with an enthusiastic and upbeat tone of voice, look cheerful and smile more frequently in the happy condition (Bono & Ilies, 2006, Van Kleef et al., 2009). In the anger condition, the confederate was told to convey the same unique ideas using an angry and irritable tone, clench his fists, and to look stern and frown a lot (Bono & Ilies, 2006). In the neutral condition, the confederate was told to act comfortably like they would in a typical discussion setting.

iMotions, a facial recognition software, was also utilized to further refine the facial expressions of the confederate and also served as a validation tool for usage in the main

research. iMotions relies on AFFDEX algorithm to measure the engagement of one or specific sets of facial muscles, and in turn, produces the probability of a discrete emotion being recorded at miniscule time frame (iMotions, 2018; McDuff, El Kaliouby, Kassam, & Picard, 2010; Stöckli, Schulte-Mecklenbeck, Borer & Samson, 2019). iMotions is increasingly used in research for its high face validity in examining facial expression according to visible changes in facial tissues, and merited on its highly non-intrusive, objective and reliable approach for emotions analysis based on the facial action unit coding system (FACs; iMotions, 2018; Stöckli et al., 2019). In this pilot study, I draw the association between the post-processed emotions data (i.e. percentage of time which the confederate displayed particular facial expression) with the intended perceived emotions ratings provided by the participants.

Methods

Participants

The pilot study was conducted in a large university in Singapore. Twenty-eight undergraduate students attended the thirty minutes psychology study session in exchange for one psychology course credit. Their mean age was 20.89 (*SD*= 1.75), and 82.1% were Chinese and 78.6% were females.

Procedures

Six to eight participants signed up for each session. They were randomly assigned to one of the three emotion conditions (i.e. happy, angry and neutral). Each participant received a survey link and a specific numeric passcode that indicates their emotional condition in the email. Upon receiving the email from the experimenter, the participant would begin the survey by reading the informed consent sheet before he/she clicks consent to proceed with the study. In the informed consent sheet, the participant was briefed that he/she would be taking

part in several short rating tasks to provide stimuli for a subsequent larger study. During the study session, he/she would be watching video-recordings of three separate discussion with different members over zoom. Instead of rating all members in each discussion, the participant was told that they would be randomly assigned to view the video recording of a specific member in each discussion, and to provide (a) ratings of that member's emotions, (b) appropriateness of the member's emotions, and (c) uniqueness of the member's ideas. By the end of the pilot study, each participant would have submitted their ratings for all three confederates in the same emotional condition. Unknown to the participants, they were deliberately presented with only the videos of the confederates who expressed the same unique ideas for both within and across different conditions, while only their non-verbal emotional content (i.e. tone, postures and facial expression) was highly varied across all three condition. In addition, the conversation for two other voice-over members within the same discussion was also highly scripted to mimic an actual team discussion where members asked questions, sought further clarification, gave feedback and suggestions to the unique ideas. This arrangement was deliberate to reduce any potential distraction from the surrounding(s), such as the emotional expression of two other members, that could influence the accuracy and reliability of the rating task. Additionally, the presentation of the three video-recordings were counterbalanced to reduce any order effect; that is, not all participants saw the video-recordings in the same order. At the end of the thirty-minute session, the participant answered some basic demographic questions (i.e. gender, age, ethnicity, etc) before they were debriefed and thanked.

Manipulation check. Following past studies, the participants rated the extent to which the member in the video was feeling "angry" and "happy" at the present moment, i.e. right now, on a 9 point scale where 1- Not at all to 9- Extremely much, right after they

watched each video clip of a member (Barsade, 2002, Van Kleef et al., 2004). $\alpha_{\_Happy\_3\ confederates}$ = .86, $\alpha_{\_Anger\_3\ confederates}$ = .70.

In order to make the desired affective displays less obvious to the participants, other ten positive affect (PA) and ten negative affect (NA) terms from the Positive And Negative Affective Schedule (PANAS) were included in the rating, also on a 9 point scale- 1 (Not at all) to 9 (Extremely much). The ten PA adjectives were "interested", "excited", "strong", "enthusiastic", "proud", "inspired", "determined", "attentive", "active" and "alert". The ten NA adjectives were "hostile", "distressed", "upset", "guilty", "scared", "ashamed", "nervous", "jittery", "afraid", "irritable". $\alpha_{male\ confederate,\ PA}$= .84, $\alpha_{male\ confederate,\ NA}$= .67; $\alpha_{female\ confederate\ 1,\ PA}$= .93, $\alpha_{female\ confederate\ 1,\ NA}$= .82, $\alpha_{female\ confederate\ 2,\ PA}$= .92, $\alpha_{female\ confederate\ 2,\ NA}$= .88. $\alpha_{PA\_3confederates}$= .82, $\alpha_{NA\_3confederates}$= .76.

Appropriateness. Participants also rated the extent to which the member's reaction was appropriate ("appropriate"), legitimate ("legitimate") and justified ("justified") on a 7 point scale where 1 (Strongly disagree) to 7 (Strongly agree). $\alpha_{male\ confederate}$ = .77, $\alpha_{female\ confederate\ 1}$ = .88; $\alpha_{female\ confederate\ 2}$= .91, $\alpha_{appropriateness\_3confederates}$= .71

Uniqueness. Participants also rated the extent to which the ideas expressed by the member was unique. An item measure- "Overall, the member produced unique ideas during the discussion." was measured on a 7 point scale- 1(Strongly disagree) to 7 (Strongly agree), $\alpha_{uniqueness\_3confederates}$= .67.

Facial expression analysis. Facial expression was measured using the AFFDEX algorithm in the iMotions software to classify the following seven emotions: sadness, anger, disgust, contempt, joy, surprise, and fear, as well as measures of engagement and valence, based on the action unit activation (iMotions, 2018; Stöckli et al., 2019). Action units can be an individual facial muscle or a muscle group, AFFDEX algorithm measures the engagement

of a specific sets of facial muscles to produce the probability of a discrete emotion at every millisecond (iMotions, 2018; Kulke, Feyerabend & Schacht, 2020). For instance, happiness is denoted by the facial muscles- smile whereas anger is denoted by a combination of six facial muscles- “brow furrow”, “eye widen”, “lid tighten”, “chin raise”, “lip suck”, and “mouth open” (Affectiva, 2017).

All video-recordings of the confederates showing happiness, anger and neutral emotions were post-processed by the AFFDEX algorithm in iMotions (iMotions, 2018; Stöckli et al., 2019). Following which, a raw data for seven discrete emotions, expressiveness/ engagement and valence of facial expressions was obtained. The continuous stream of data obtained for each respondent as a raw data was further broken down into multiple intervals of 520 miliseconds and the median of facial expression was obtained for each interval. If the median value within a time interval of 520 miliseconds exceeds a threshold of 50 — which represents an even odd that the facial muscle was engaged or the emotion was detected (Stöckli et al., 2019)—was assigned a value of 1(“true”) or 0(“false”). These thresholds do not indicate an absolute presence or absence of the emotions, while other emotions that do not meet the threshold were defined as neutral or lack of facial expression (Broach-Due, 2018). Through these procedures, a sum of all the binary responses would produce a visualization of the total number of occurrences of a specific facial expression for each respondent (Broach-Due, 2018). In this study, I calculated the percentage of time that joy and anger facial expression was displayed by the confederates across all three conditions. Running the scale reliabilities on iMotions_results for the three confederates for anger and happy, we achieved α_{anger}=.85 and α_{happy}=.85.

Results

Manipulation Check. The pilot study examined effectiveness of existing emotional content and non-verbal emotional content in portraying the intended emotions in the three emotional conditions. Thus, the perceived ratings of anger for the three confederates were aggregated to form a mean level of perceived anger in the same emotional condition. The scale reliabilities of perceived anger for the three confederates were high; $\alpha = .70$, thus justifying the aggregation of perceived ratings of anger to its mean level. Similarly, the perceived ratings of happiness for the three confederates were aggregated to form a mean level of perceived happiness in the same emotional condition. The scale reliabilities of perceived happy for the three confederates were high; $\alpha = .86$, thus justifying the aggregation of perceived ratings of happy to its mean level.

A one-way ANOVA was ran to examine whether the mean level of perceived happy ratings of the confederates differed across the three emotion condition. There was a significant effect of condition on the mean level of perceived happy ratings, $F(2, 25) = 42.39$, $p < .001$. A post-hoc Tukey HSD analysis revealed that the mean level of perceived happy ratings was significantly higher in the happy condition ($M = 5.57$, $SD = 1.29$) than of the angry condition ($M = 1.46$, $SD = .53$), $t(12.53) = 9.16$, $p < .001$, and also that of the neutral condition ($M = 3.47$, $SD = .77$), $t(18) = 4.42$, $p = .001$. In addition, the mean level of perceived happy rating was also significantly different for the neutral condition and anger condition, $t(16) = 6.24$, $p < .001$.

A one-way ANOVA was run to examine whether the mean level of perceived anger ratings of the confederates differed across the three emotion conditions. There was a significant effect of condition on the mean level of perceived anger ratings, $F(2, 25) = 24.46$, $p < .001$. A post-hoc Tukey HSD analysis revealed that the mean level of perceived anger

ratings (*M*= 7.21, *SD*= 1.01) was significantly higher than happy condition (*M*= 3.27, *SD*= 1.49), t(16)= 6.39, *p*<.001, and also that of the neutral condition (*M*= 3.60, *SD*= 1.28), t(16)= 6.50, *p*<.001. In addition, the mean level of perceived anger rating was not different for the happy condition and neutral condition, t(18)= -.54, *p*=.60.

Appropriateness. The perceived appropriateness ratings were aggregated across confederates within the same emotional condition to represent its mean level of appropriateness. The scale reliabilities of perceived appropriateness ratings for the three confederates were high; α= .71, thus justifying the aggregation of perceived ratings of appropriateness to its mean level. A one-way ANOVA was run to examine if perceived appropriateness varied across the three emotion conditions. There was a significant effect of condition on perceived appropriateness ratings, F(2, 25)= 12.48, *p*<.001. By running post-hoc tests using Tukey HSD, the perceived appropriateness was significantly lower in the anger condition (*M*= 4.07, *SD*= .78) than the happy condition (*M*= 5.44, *SD*= .67), t(16)= -4.03, *p*=.001, and also that of the neutral condition (*M*= 5.41, *SD*= .50), t(16)= -4.44, *p*<.001. The perceived appropriateness ratings was not significantly different between the happy and neutral condition, t(18)= -.13, *p*=.90.

Uniqueness. The perceived uniqueness ratings of the confederates' ideas were aggregated across confederates within the same emotional condition to represent its mean level of uniqueness. The scale reliabilities of perceived uniqueness ratings for the three confederates were high; α= .67, thus justifying the aggregation of perceived ratings of uniqueness to its mean level. A one-way ANOVA was run to examine if perceived rating of uniqueness varied across condition. There was no significant effect of the three conditions on perceived ratings of uniqueness, F(2, 25)= 1.27, *p*=.30.

Facial expression. Following the approach described above, I sought to understand the association between the post-processed emotions data (i.e. percentage of time the participants displayed a particular facial expression in each condition) with the confederate's perceived emotions as rated by the participants. From the iMotions data, the female confederate 1's proportion of happy expression correlated positively with the perceived happy rating by members, r= .67, p<.001 and did not significantly negatively correlated with the perceived anger ratings by members, r=-.28, p=.15. On the other hand, iMotions data of the female confederate 1's proportion of anger expression correlated positively with perceived anger ratings by the members, r= .54, p=.003, and correlated negatively with perceived happy ratings by the members, r= -.66, p<.001.

iMotions data from the male confederate's proportion of happy emotions correlated positively with the perceived happy ratings by members, r= .71, p<.001, and correlated negatively with the perceived anger ratings by members, r=-.50, p<.01. iMotions data from male confederate's proportion of anger expression correlated positively with anger ratings by members, r=.83, p<.001 and correlated negatively with happy ratings by members, r= -.75, p<.001.

iMotions data from the female confederate 2's proportion of happy expression correlated positively with the perceived happy ratings by members, r=.63, p<.001, and did not significantly correlated negatively with the perceived anger ratings by members, r= -.19, p=.34. Imotions data from female confederate 2's proportion of anger emotions correlated positively with anger ratings by members, r= .51, p=.01, and correlated negatively with happy ratings by members, r= -.56, p=.002.

iMotions could detect subtle changes in confederate's anger and happy that corresponded positively to how participants perceived the confederate's emotions across

different conditions. Therefore, iMotions is a good facial analysis tool that could be used in any discussion setting similar to this study. Taken together, the pilot study supported the effectiveness of the current verbal and non-verbal emotional content to be used in the main study.

Chapter 8
Main study

Purpose

The purpose of this study was to examine the proposed model of happy and angry emotions of unique opinion holder on team creativity. Participants were randomly assigned to teams with three to four members in an experimental setting conducted virtually over Zoom. Based on the estimated effect size (η^2 = .163) calculated in Grawitch, Munz & Kramer (2003) that manipulated team mood in the three conditions in an experimental setting, a priori power analysis was conducted with α= .05, power = .95, and conditions= 3. Using the G* power for power analysis, a total of 96 teams would be required. The number of teams used in this study has exceeded the required sample size of 96 teams thus this study is sufficiently powered.

Method

Sample and Task

The study was conducted at a large university in Singapore. Three hundred and ninety-six undergraduate students who participated for either two psychology course credit or monetary compensation of $10. The participants were randomly assigned to 124 teams consisting of two to four members, excluding the confederate. However, one team was excluded as a member failed to complete the working memory measure. The final sample size was 123 teams consisting of two to four members, excluding the confederate. The average number of study participants per team was *M*= 3.20 (*SD*= .72). There were 41 teams in the neutral condition, 41 teams in the happy condition and 41 teams in the angry condition. Their mean age was 22.07 (*SD*= 1.83), and 77.3% were females and 82% of the participants were Chinese.

Procedures

Interested students registered for the study on Subject Pool System (SPS) in Singapore Management University. Three to four participants were instructed to come for their scheduled slot on Zoom. Upon arrival in the zoom discussion room, participants were welcomed and seated before the experimenter briefed them further about the tasks. They then answered some questionnaires individually before they partake in group discussion with three to four members on a task, and then followed up with post-discussion questionnaire.

In the beginning of the task, participants answered some individual measures, such as trait optimism measure, Big 5 personality, need for cognition scale, creative self-efficacy, etc. These measures assessed constructs that are important correlates to creative performance, working memory, and emotional susceptibility for individuals in previous studies (Blagrove & Hartnell., 2000; Hsu, Hou & Fan., 2011). Following these measures, participants were asked to report their present levels of positive and negative mood using Positive and Negative Affective Schedule (PANAS), which served as Time 1 mood.

Next, the participants were informed that they would work with members in the same Zoom call on an idea generation task where they would generate as many high-quality ideas as possible to improve an existing problem in Singapore. Before they were further briefed on the main task, the experimenter gave three minutes for all members, including the confederate, to have self-introduction and to create a team name as to foster some levels of group entitativity. Following which, the experimenter would spin a virtual wheel to determine the speaking order during the first round of the discussion, and all participants were informed that this order does not have to be followed throughout the discussion, i.e. the discussion becomes more free-flow. Unknown to the participants, the confederate (member A1) in the experiment will always get to speak first due to unevenly loaded spin wheel. This introduced

speaking order minimized any group differences that arise from participants' initial exposure to the confederate. This methodology was similarly used in previous studies that required the participants to draw lots to determine the speaking order, and the confederate would get the longest pick get to speak first (Barsade, 2002).

In the main task, the participants, including the confederate, will work as a team to brainstorm as many high quality ideas on improving the quality of online education in Singapore in the long run. In particular, students were informed that online learning has two main aspects of getting access to a diversity of topics and the opportunity of socializing and learning well with peers online. They worked on this task collectively for twelve minutes while an assigned member took on the role of a scribe to type down all the team's ideas in the textbox in the survey. All other members were told to stay focused on the task and the exchanges of ideas among members. To sustain some levels of task motivation, teams were informed that top 10% of the performing teams will receive an additional reward of $10 per member, and their ideas will be submitted to the school management for further consideration. The creative ideas would be rated by independent coders to assess team creativity in both aspects of originality and practicality. Additionally, the video-recordings obtained from each team would be transcribed for coders to code for team processes of team information elaboration and team generative processing, which should emerge from members' interaction with one another during the discussion.

At the end of the team discussion, participants submitted their ratings on the current levels of positive and negative mood on PANAS, as well as their own ratings of happiness and anger, that served as Time 2 mood ratings. Additionally, participants also evaluated each other's moods using "angry, "happy", ten PA adjectives, ten NA adjectives, and the appropriateness of emotions and uniqueness of the ideas. Consistent with the pilot study, only the confederate (i.e. member A1)'s ratings of "angry and "happy" served as manipulation

check measures. In addition, the participants also completed several post questionnaires, such as team satisfaction, team reflexivity, etc.

Next, participants took a three minutes break and then completed an operation span task which indexed working memory measure at the individual level. The participants were then debriefed, thanked and paid for their participation in the study. The whole experiment for part 1 ended in around forty minutes.

Within the span of the next few days, the experimenters followed up with the participants to complete part 2 of the study. Part 2 study involves the collection of individual differences measures and two more working memory tasks. Specifically, participants completed the reading span task, followed by a Big 5 personality measures, and then a Stroop span task. Part 2 study ended in around twenty minutes.

Confederates. Confederates were recruited to join the discussion with the participants to convey happy, anger or neutral emotions during the expression of unique ideas. The use of confederates for emotion manipulation would lend greater control to the study, reduce task-related variances, and also utilized in past studies as an effective and appropriate means of conveying emotions to participants working in team (Barsade, 2002). Three confederates, one male and two females, were recruited from the theatre club and emcee club in the university. They had at least a year of experience in theatre performance prior to joining the study. Their theatre or emcee background and previous training allow them to easily dissociate themselves from the task, and channel all of their energies towards maintaining the verbal and non-verbal aspects of the emotions to be highly standardized within the same condition. In addition, as the confederates are also undergraduate students from the same university, this shared background sets stage for the occurrence of emotional contagion (Barsade, 2002).

All confederates were blind to the experimental hypotheses, purposes and the goal of the study. They were rigorously coached in both verbal and non-verbal affective behaviors for all condition. For the verbal aspect, the confederates followed closely to the unique idea expressions written in the script (see Appendix A), except for the rationale statement said at the start of all discussion "*I think schools, in general, have already put in some steps to prepare their students for online learning. I am really happy with the arrangement and I just think that there is so much more we should do with online learning, especially with covid right now.*", where they were told to add in "really happy" for happy condition, and no adjective for the neutral condition. In the anger condition, the rationale statement was "*I think schools, in general, have not prepare their students enough for online learning. I am really angry with the arrangement, and I just think that there is so much more we should do with online learning, especially with covid right now.",* where "really angry" was added for the anger condition (Van Kleef et al., 2014). The rationale statement was added to provide a context to participants on why the confederate was happy or angry prior and during the expression of unique ideas. The emotions without justification tend to be perceived as inappropriate and would not be deeply processed by the perceiver (Bucy, 2000). Similar to the pilot study, for the non-verbal aspects of happy behavior, the confederate was told to speak the same unique ideas with an enthusiastic and upbeat tone of voice, look cheerful and smile more frequently (Van Kleef et al., 2009). In the anger condition, the confederate was told to convey the same unique ideas using an angry and irritable tone, clench his/her fists, and to look stern and frown a lot (Bono & Ilies, 2006). In the neutral condition, the confederate was told to behave comfortably as they would in a typical discussion (Van Kleef et al., 2009). As the discussion for the idea generation task is a free-form and non-structured task, the confederate was expected to make improvisation towards his/her speech following members' questions and feedback, however, all the informational content of speech was kept

as constant as possible for all teams while their focus remains at varying their non-verbal affective behavior across conditions.

Measures

Manipulation check. Similar to the pilot study, the participants were asked to indicate the extent to which the member in the discussion was feeling "angry" and "happy" at the present moment, i.e. right now, on a 9 point scale where 1- Not at all to 9- Extremely much, right after they ended the discussion (Barsade, 2002, Van Kleef et al., 2004). In order to make the confederate's identity less obvious, the manipulation check was framed as a member's evaluative task where they would rate each other on their affective displays. In reality, only member A1 (i.e. confederate)'s happy and anger emotions served as manipulation check measures. $R_{wg\ (happy)}$=.59, ICC(1)= .48, and ICC(2)= .74. $R_{wg\ (angry)}$=.66, ICC(1)= .56, and ICC(2)= .80.

Affective measure. In order to make the desired affective displays less obvious to the participants, ten other adjectives from the abbreviated Positive and Negative Affect Schedule (PANAS) were included (Thompson, 2007). The PANAS is a commonly used measure of state affect and being widely used as a valid and reliable measure of both positive and negative affect (Crawford & Henry, 2004). Five positive affect (PA)- "active", "inspired", "attentive", "determined" and "alert", and five negative affect (NA) terms- "hostile", "ashamed", "nervous", "afraid" and "upset"- were included in the rating of happy and anger ratings, also rated on a 9 point scale- 1 (Not at all) to 9 (Extremely much). $\alpha_{NA\_confederates}$= .82; $\alpha_{PA\_confederates}$= .81. $R_{wg\ (PA)}$=.59, ICC(1)= .06, and ICC(2)= .16. $R_{wg\ (NA)}$=.77, ICC(1)= .23, and ICC(2)= .49.

Appropriateness. I also measured how much the other party's reaction was expected ("expected"), seemed genuine ("genuine"), and seemed believable ("believable") on a 7 point

scale- 1(Strongly disagree) to 7(Strongly Agree). $\alpha_{appropriateness\_memberA1}$= .93. R_{wg} =.81, ICC(1)= .34, and ICC(2)= .62.

Uniqueness. The uniqueness scale was assessed by a single-item measure, "Overall, the member produced unique ideas during the discussion." on a 7 point scale- 1(Strongly disagree) to 7(Strongly Agree). R_{wg} =.80, ICC(1)= .11, and ICC(2)= .28.

Operation word span task (OSPAN). Operation word span task was one of the three tasks presented to participants in assessing working memory capacity (Kane & Engle, 2000). All of the working memory tasks was programmed using Javascript in the Qualtrics survey with the stipulated time interval specified below. Participants were instructed to answer a series of math operations while trying to memorize a set of unrelated words interspersed in between the math operations. For instance, in a complete operation-word pair, participants would be presented with a math problem "(9/3)= 5?" in the center of their computer screen and they need to immediately indicate "F" (i.e. True) or "J" (i.e. False) on their keyboard. After the math problem, participant was presented with a word, i.e. "Book", for them to remember for 1s. After showing a blank screen for 0.2s followed by a plus sign (i.e. fixation point) for 0.5s, the participants were then automatically presented with the next operation-word string. The operation-word strings had different set sizes. For example, for set size 5, participants were presented with a total of 5 sets of operation-word pairs, and they had to then type down the 5 words in the correct order as soon and as accurately as possible when they were prompted to recall ("Recall now"). Two trials of each set size (set size 3-6) were presented. Additionally, participants were presented with the set sizes at random so they could not predict the number of operation-word string sets.

Reading span. The reading span task was adapted from Unsworth et al. (2005), a second task used in assessing working memory capacity in this study. For this reading span

task, the participants were told to read the sentences while trying to memorize a set of unrelated words. For each trial, participants read a sentence and determined whether it was semantically correct or incorrect (e.g. “The young pencil kept his eyes closed until he was told to look.”). This sentence was semantically incorrect since the sentence has no useful meaning. For sentences that are semantically correct, the participants had to indicate “F” on the keyboard, and “J” on the keyboard if semantically incorrect. After the sentence, the participant was presented with a word “poetry” for 1s. After showing a blank screen for 0.2s and a plus sign for 0.5s, the participants were automatically presented with the next sentence-letter string. Similar to the OSPAN task, the sentence-letter strings were grouped into sets of 3-6. For example, for set size 5, participants will be presented with 5 sets of sentence-word pairs, and had to type down the 5 words in the correct order as soon and as accurately as possible when they were prompted to recall (“Recall now”). A practice trial of set size 5 was included. There were two trials of each set size, with set size ranging from 3 to 6. The set szes were presented to participants in a random order so they could not predict the number of sentence-word string sets.

Stroop- span task. Stroop-span task was adapted from Yang & Yang (2017). Participants were presented with a sequence of Stroop words- i.e. four color words printed in congruent and incongruent colors while trying to remember a set of unrelated alphabet letters. Participants pressed different keys on the keyboard to indicate the ink color in which each color word was printed; “D” (indicates red), keyboard “F” (indicates blue), “H” (indicates green) and “J” (indicates yellow). Right after, they were presented with an alphabet for 1s. After showing a blank screen for 0.2s and a plus sign for 0.5s, the participants were automatically presented with the next color word-alphabet string. The colour word-alphabet strings were grouped in sets for 3-6. For example, for set size 5, participants were presented with 5 sets of color word-alphabet pairs, and then they had to type down the 5 alphabets in

the correct order as soon and as accurately as possible when they were prompted to recall ("Recall now"). There were two trials of each set size, with set size ranging from 3 to 6. A practice trial of set size 5 was included. The presentation of set sizes varied randomly so participants could not predict the number of Stroop letter- alphabet string sets.

All of the three tasks- Operation span task, Reading span task and Stroop span tasks- assess the participants' working memory capacity. The correct responses for all these three tasks were calculated using the Partial Credit Unit procedure (PCU) and the Partial Load Unit (PCL) procedure. PCU expresses a participant's working memory score as the proportion of total number of correct words being recalled in a set (Conway, Kane, Bunting, Hambrick, & Engle, 2005; Yang, Yang & Isen, 2013). For instance, a participant would receive a score of 0.4 if she or she remembers two words out of five words in a set (Yang, Yang & Isen, 2013). On the other hand, PCL assesses the total number of words recalled across all sets (Conway et al., 2015). Both PCU and PCL demonstrated similar results, but only PCU scores were utilized for the main model as past studies found that PCU had better psychometric properties than the PCL scores (Conway et al., 2015; Yang, Yang & Isen, 2013). The PCU score for each of the three working memory tasks were averaged to form the mean level of working memory capacity for each individual. To compute the working memory capacity at the team level, I averaged the working memory capacity scores for members within the team.

Team information elaboration. Information elaboration, which refers to the exchanging, processing, and integrating of information and perspectives, was assessed via video recordings of each team's discussion session using the coding scheme developed by Hoever, Van Knippenberg, Van Ginkel & Barkema (2012). The two independent coders who were blinded to the experimental condition rated the team information elaboration for the teams. Similar to the approach in Pillay et al. (2020), a random selection of 24% of the recordings (i.e. 29 teams) were rated by a coder whereas the other coder rated all recordings

on team information elaboration for all teams. A score of 1 was assigned when team members largely ignore the ideas and information expressed during a discussion and a score of 7 was assigned when ideas and information shared during a discussion were acknowledged and elaborated by all team members. For the shared coding analysed under uniform distribution, $R_{wg} = .91$, $ICC_1 = .72$, $ICC_2 = .82$. The agreement and reliability measures were acceptable which justified the aggregation of the two coder's ratings to its mean-level to represent team information elaboration.

Team Generative Processing. Following Hoever et al.'s (2018) coding scheme, generative processing was assessed as the emergence of divergent thinking stimulated by the output of other members. Two separate and independent coders were trained to identify statements that either (1) drew parallels between the existing task's setting and other contexts to generate ideas triggered by the input of other team members, (2) represented half-baked ideas in response to other team members' suggestions, ideas, or perspectives, and (3) represented utterances that were irrelevant or poorly linked to the previous member's ideas. One rater rated team generative processing for all teams while the second rater rated a random selection of 24% of the recordings (i.e. 29 teams) (Pillay et al., 2020). The inter-rater reliability between the two coders was $R_{wg} = .86$, $ICC_1 = .68$, $ICC_2 = .81$. The agreement and reliability measures were acceptable which justified the aggregation of the two coder's ratings to its mean-level to represent team generative processing.

Team idea originality. Two independent coders rated the originality of ideas developed by each group using a scale of 1 ("Not unique at all") to 5 ("Extremely unique"), $R_{wg} = .72$, $ICC_1 = 0.42$, $ICC_2 = 0.60$. As the inter-rater statistics indicated substantial agreement between the two raters, their ratings could be aggregated to represent team idea novelty.

Team idea practicality. The same set of independent coders rated the practicality of ideas developed by each group using a scale of 1 ("Not practical at all") to 5 ("Extremely practical"), $R_{wg} = .78$, $ICC_1 = .48$, $ICC_2 = .65$. As the inter-rater statistics indicated substantial agreement between the two raters, their ratings could be aggregated to represent team idea practicality.

Team creativity. Following past studies, we first assessed the two facets of originality and practicality separately (Salazar, Feitosa & Salas, 2017), which was subsequently averaged to represent team creativity (Pirola-Merlo & Mann, 2004).

Results

In this analysis, I aggregate all manipulation checks and affective reactions measured at the individual level to the team level as participants within the same team were exposed to the unique opinion holder's emotions at the same time (Van Kleef et al., 2009). This is because the participants were exposed to the unique member's emotions as a team, the direct consensus model represents a common conceptualization of the team-level variable (Van Kleef et al., 2009). For the direct consensus model, members need to establish some degree of consensus within the team before it is appropriate to aggregate the individual-level construct to the team level construct (Chan, 1998). To examine if the aggregation to the team was appropriate, we first calculated the R_{wg} (uniform null distribution), ICC(1), and ICC(2). Past studies on team emotions have typically obtained R_{wg} values (i.e. indexing the measure of agreement within the group) of approximately .75 to .89 and ICC(1) of .12 as indicative of how much group membership accounts for the variance in the focal group (e.g., Grawitch, Munz, Elliott, et al., 2003; Tsai et al., 2012). For this study, the R_{wg} for perceived happy, anger, appropriateness and uniqueness ratings of the confederates ranged from .59 to .81, ICC(1) ranged from .11 to .56, and ICC(2) ranged from .28 to .80. Even though the R_{wg} for

perceived happy and angry ratings were lower than the R_{wg} reported in the literature, however, they met the ICC(1) values thus justifying their aggregation to the team level.

The main hypotheses, except hypothesis 1a and 1b, were examined using the PROCESS macro in SPSS, which were appropriate for testing mediational and moderated mediation model with a multi-categorical independent variable with a bootstrapping procedure with bias and accelerated confidence intervals of 5000 resamples (Hayes, 2013). The path estimates in the model were obtained using ordinary least square regression analyses (Hayes, 2013). The specified model (i.e. model 4) allows for the testing of multiple mediators in the same model whereas model (i.e. model 7) allows for the moderation of the first stage of the indirect effects in the mediational pathways (Hayes, 2013).

Following the recommendation by Hayes and Preacher (2014), the emotional condition was dummy-coded where neutral condition served as a referent category for accessing the direct and indirect effects of the team processes variables (i.e. team information elaboration and team processing creativity) on dependent variables. For the independent variable "condition", we computed two contrasts consistent with our theoretical approach and the indicator coding scheme (Strelan, Van Prooijen & Gollwitzer., 2020), we compared happy condition (coded 1) with the neutral condition (0) in contrast 1 and we compared anger (coded 1) with the neutral condition (0) in contrast 2. In each contrast, the neutral condition was coded as 0.

Manipulation check. A one-way ANOVA was run to examine whether the team level of perceived happy ratings of the confederates differed across the three emotion conditions. There was a significant effect of condition on the team level of perceived happy ratings, $F(2, 120)= 72.22$, $p<.001$. A post-hoc Tukey HSD analysis revealed that the team level of perceived happy ratings was significantly higher in the happy condition ($M= 6.98$,

SD= 1.22) than of the angry condition (*M*= 3.63, *SD*= 1.42), t(80)= 11.45, *p*<.001, and also that of the neutral condition (*M*= 4.85, *SD*= 1.18), t(80)= 8.04, *p*<.001. In addition, the team level of perceived happy rating was also significantly higher in the neutral condition than the anger condition, t(80)= 4.23, *p*<.001.

A one-way ANOVA was run to examine whether the team level of perceived anger ratings of the confederates differed across the three emotion conditions. There was a significant effect of condition on the team level of perceived anger ratings, $F_{welch}(2, 63.38)= 58.13$, *p*<.001. A post-hoc analysis using Games-Howell revealed that the team level of perceived anger ratings in the anger condition (*M*= 4.94, *SD*= 2.17) was significantly higher than happy condition (*M*= 1.34, *SD*= .43), t(43.12)= 10.42, *p*<.001, and also that of the neutral condition (*M*= 1.97, *SD*= .97), t(55.44)= 7.99, *p*<.001. In addition, the team level of perceived anger rating was significantly higher in the neutral condition than in the happy condition, t(54.99)= 3.81, *p*<.001.

Appropriateness. The perceived appropriateness ratings were aggregated across team members in the same team. A one-way ANOVA was run to examine if perceived appropriateness varied across condition. There was a significant effect of condition on perceived appropriateness ratings, $F_{welch}(2, 75.91)= 22.97$, *p*<.001. By running post-hoc using Games-Howell analysis, the perceived appropriateness was significantly lower in the anger condition (*M*= 5.09, *SD*= .92) than the happy condition (*M*= 6.10, *SD*= .45), t(58.72)= -6.36, *p*<.001, and also that of the neutral condition (*M*= 6.15, *SD*= .50), t(62)= -6.50, *p*<.001. The perceived appropriateness ratings was not significantly different between the happy and neutral condition, t(80)= .411, *p*=.68.

Uniqueness. The perceived uniqueness ratings of the confederates' ideas were aggregated across members in the same team to represent its mean level of uniqueness. A

one-way ANOVA was run to examine if perceived rating of uniqueness varied across condition. There was a significant effect of condition on perceived ratings of uniqueness, $F_{welch}(2, 77.23)= 8.13$, $p=.001$. By running post-hoc analysis using Games-Howell, the uniqueness ratings was significantly lower in the anger condition ($M= 5.80$, $SD= .76$) than the happy condition ($M= 6.31$, $SD= .45$), $t(65.08)= -3.72$, $p<.001$, and also that of the neutral condition ($M= 6.34$, $SD= .51$), $t(70.18)= -3.77$, $p<.001$. The perceived uniqueness ratings was not significantly different between the happy and neutral condition, $t(80)= .25$, $p=.81$.

Main study results

Hypothesis 1a proposed that team generative processing would be positively associated with team creativity. Team creativity was positively correlated with team generative processing, $r= .23$, $p=.01$. Even after controlling for team information elaboration, team creativity was positively correlated with team generative processing, $r= .27$, $p=.002$. Thus, Hypothesis 1a was supported.

Hypothesis 1b proposed that team information elaboration would be positively associated with team creativity. Team creativity was positive but not significantly correlated with team information elaboration, $r= .14$, $p=.14$. Controlling for team generative processing, team creativity was positively correlated with team information elaboration, $r= .20$, $p=.03$. Thus, Hypothesis 1b was supported only after adjusting for team generative processing as a covariate.

Hypothesis 2a and 2b was ran in the same parallel mediation model to examine the influence of the conditions on team creativity as being mediated by two processes- (a) team generative processes (hypothesis 2a) and (b) team information elaboration (hypothesis 2b). The parallel mediation model was ran without any covariates, and then a separate parallel mediation model was ran to control for team size and the number of ideas expressed by the

confederates in the discussion. The models without any covariates were reported in this section whereas both path diagrams with and without covariates could be found in Appendix B.

Hypothesis 2a proposed that as compared to teams with a neutral unique opinion holder, teams with a happy unique opinion holder who expresses unique ideas should achieve higher team creativity through greater team generative processing. There was a positive influence of contrast 1 (happy (vs. neutral)) on team generative processing, β= .90, b= 1.48, S.E.= .33, p<.001. Also, team generative processing also positively predicted higher levels of team creativity, β= .28, b= .13, S.E.= .04, p=.01. Overall, teams with a happy (vs. neutral) unique opinion holder significantly influenced team creativity indirectly through team generative processing, b= .19, S.E.= .07, 95% CI [.06, .35]. Separately controlling for team size and the number of ideas expressed by the confederate, similar results was obtained for hypothesis 2a. Thus, hypothesis 2a was supported (*See Figure B1*).

Hypothesis 2b proposed as compared to teams with a neutral unique opinion holder, teams with an angry unique opinion holder who expresses unique ideas should achieve higher team creativity through higher team information elaboration. There was an effect of contrast 2 (anger (vs. neutral)) on team information elaboration, β= .63, b= .82, S.E.= .27, p=.003. Also, team information elaboration also positively predicted higher levels of team creativity, β= .20, b= .11, S.E.= .05, p=.05. Overall, teams with an angry (vs. neutral) unique opinion holder significantly influenced team creativity indirectly through team information elaboration, b= .09, S.E.= .05, 95% CI [.004, .22]. Controlling for team size and the number of ideas expressed by the confederate, same result was obtained for hypothesis 2b. Thus, hypothesis 2b was supported (*See Figure B1*).

Hypothesis 3a proposed that there was a moderating influence of team working memory on happy (vs. neutral) unique opinion holder on team generative processing. Team working memory was the mean-level measure of all working memory capacity for members in the same team. There was a non-significant interaction between happy (vs. neutral) unique opinion holder and team working memory capacity on team generative processing, b=2.21, SE= 7.19, *p*=.76. Similar result was obtained when team size and the number of ideas expressed by the actor was separately controlled for. Hypothesis 3a was not supported (*See Figure B9*).

Hypothesis 3b proposed that there is a moderating influence of team working memory on anger (vs. neutral) unique opinion holder on team information elaboration. There was a non-significant interaction effect between angry (vs. neutral) unique opinion holder and team working memory on team information elaboration, b= 6.01, SE= 4.92, *p*= .22. Similar result was obtained when we separately control for team size and number of ideas expressed by the actor. Hypothesis 3b was not supported (*See Figure B7*).

Chapter 9
Exploratory analysis of Originality and Practicality of team ideas

In team creativity studies, team creativity is defined in terms of both originality and practicality of the ideas (Gino et al., 2010; Hoever et al., 2018). Past studies found that individuals relied on distinct thinking processes to achieve ideas that are original or practical. Specifically, the generation of original ideas require one to think "out-of-the box" and break free from existing structure, thus feasibility of the idea might be reduced (Hoever et al., 2018). On the other hand, practical ideas depend on refining ideas based on well-established guidelines thus hindering the novelty aspects of the ideas (Audia & Goncalo, 2007; Grant & Berry, 2011). Building upon previous studies that examined idea originality and practicality as outcomes of distinctive processes, this study contributes to the team creativity literature by specifying the information processing dynamics that teams are more likely to utilize for originality and practicality of the ideas.

Specifically, team generative processing would increase team's originality of ideas. This process focuses on how team members would actively trigger distinct ideas off each other's semantic network of ideas (Hoever et al., 2018). Through the activation of concepts found within and across members' semantic network, the strongly related concepts at the beginning would gradually deplete and allow the teams to gain access to more distinct and unusual association of the ideas. As team members take advantage of the associative nature of ideas among team members in generating ideas for online learning in Singapore, more unusual ideas such as "providing studying home kits for experiments" would emerge and be more accessible for members as they listened to other members' ideas such as "provide laptop for financially challenged students", "provide tables", etc. As the teams continuously roll out ideas in a divergent manner, they are increasingly adept to generate more unique ideas using team generative processing.

On the other hand, team information elaboration is known to drive higher ideas' practicality. Team information elaboration helps team to better understand the multi-facted nature of the problem which guides their refinement and advancement of ideas with more relevant inputs (Hoever et al., 2012). For instance, a team working on improving the online learning might realize the interrelated yet conflicting aspects of feasibility and novelty of ideas (Lewis, 2000). By engaging in team information elaboration, teams would understand the task's objectives where they know how to steer away from impractical ideas that are costly, for instance, to install a tracking device for all students' laptop to monitor their attention span during online lesson. Instead, they might propose ideas such as incorporating an existing technology of VR to computer-related modules to help students better grasp the concepts while learning online. The eventual output will take this idea further in addressing the essential and practical aspect by members who collectively advance, critique and move the ideas further. Ultimately, the team could develop solutions that are more detailed and sophisticated that what an individual could produce alone.

Therefore, I examined team originality as a dependent variable that could be influenced by different team information-processing routes. Specifically, I postulate that teams with a happy (vs. neutral) unique opinion holder should achieve higher team originality of ideas through greater team generative processing. Additionally, teams with an angry (vs. neutral) unique opinion holder would not differ in team originality despite that team information elaboration would be higher in teams with an angry unique opinion holder than those with a neutral unique opinion holder.

There was an effect of contrast 1 (happy vs. (neutral)) on team generative processing, β= .90, b= 1.48, S.E.= .33, p<.001. Team generative processing positively predicted higher levels of team originality, β= .28, b= .17, S.E.= .06, p=.01. Overall, teams with a happy (vs. neutral) unique opinion holder significantly influenced team originality indirectly through

team generative processing, b= .26, S.E.= .10, 95% CI [.08, .48]. Even though, there was a significant effect of contrast 2 (anger vs. (neutral)) on team information elaboration, β= .63, b= .82, S.E.= .27, p=.003. However, team information elaboration did not significantly predict higher levels of team originality, β= -.04, b=.-03, S.E.= .07, *p*=.64. However, teams with an angry (vs. neutral) unique opinion holder did not significantly influence team originality indirectly through team information elaboration, b=-.03, SE= .06, 95% CI [-.17, .10] (*See Figure B3*). Same result was obtained when we separately controlled for team size and number of ideas expressed by the actor. Therefore, the effects of unique opinion holder's happy (vs. neutral) emotion is said to uniquely influence team originality through team generative processing.

Next, I examined team practicality as a dependent variable that could be influenced by different team information-processing routes. Specifically, I postulate that teams with a angry (vs. neutral) unique opinion holder should achieve higher team practicality of ideas through greater team information elaboration. Additionally, teams with a happy (vs. neutral) unique opinion holder would not differ in team practicality despite that team generative processing would be higher in teams with a happy unique opinion holder than those with a neutral unique opinion holder.

There was a significant effect of contrast 2 (anger (vs. neutral)) on team information elaboration, β= .63, b= .82, S.E.= .27, *p*=.003. Team information elaboration also positively predicted higher levels of team practicality, β= .36, b= .25, S.E.= .06, *p*=.0002. Overall, teams with an angry (vs. neutral) unique opinion holder significantly influenced team practicality indirectly through team information elaboration, b= .21, S.E.= .09, 95% CI [.05, .41]. Even though there was an effect of contrast 1 (happy (vs. neutral)) on team generative processing, β= .90, b= 1.48, S.E.= .33, *p*<.001, team generative processing did not significantly predict higher levels of team practicality, β= .14, b= .08, S.E.= .05, *p*=.15.

Teams with a happy (vs. neutral) unique opinion holder did not significantly influence team practicality indirectly through team generative processing, b=.11, SE= .08, 95% CI [-.02, .28] (*See Figure B5*). Same result was obtained when we separately controlled for team size and number of ideas expressed by the actor. Therefore, the effects of unique opinion holder's angry (vs. neutral) emotion is said to uniquely influence team practicality through team information elaboration.

By investigating the two facets of team creativity (i.e. team originality and team practicality), this study found the unique influence of positive emotions on team originality through increased team generative processing. Additionally, there was also a unique influence of negative emotions on team practicality through greater team information elaboration.

Chapter 10
Exploratory analysis of confederates' gender

In our study, our confederates were of different genders. According to past studies, people do draw inferences from the emotions displayed by the target member but the inferences from anger expression tend to different from males to females (Brescoll & Uhlmann, 2008; Salerno and Peter-Hagene, 2015). When presented with situational context to the anger expression of both male and female in the pictures, people naturally associated female expression of anger to internal causes (being emotional) rather than to situational causes presented about the target (Brescoll & Uhlmann, 2008; Barrett & Bliss-Moreau, 2009). On the contrary, people attributed male expression of anger to external and situational sources (i.e. having a bad day) (Brescoll & Uhlmann, 2008; Barrett & Bliss-Moreau, 2009). Additionally, anger expression by different gender also implicated their perceived competence by others. Anger expression tends to increase perceived competence by men but decrease perceived competence by women (Brescoll & Uhlmann, 2008; Tiedens, 2001).

Building on this line of gender differences for anger expression, Salerno and Peter-Hagene (2015) examined the anger, fear and neutral expression of a male or female hold-out dissenter in response to majority's answer in a jury deliberation trial in a computerised setting. Each participant was instructed to view himself/ herself as a member of the six-members jury team where they need to report their confidence level in the verdict after the seventh round of discussions where they heard expressions made by all members, including a male or female holdout who presented his/her dissenting viewpoints with anger, fear or no emotion (Salerno & Peter-Hagene, 2015). In the study, they found no influence of fear and neutral expression on participants' opinions, but there was an influence of anger emotions (Salerno & Peter-Hagene, 2015). Participants that interacted with a male hold-out dissenter became less confident in their verdict over different rounds of discussion as they perceive the

anger expression to be more emotional and also of higher credibility (Salerno & Peter-Hagene, 2015). On the contrary, participants that interacted with a female hold-out perceived her anger expression to be more emotional and less credible, thus they became more confident in their verdict over different rounds of discussion (Salerno & Peter-Hagene, 2015). The study showed that anger was a persuasive tool when expressed by males so much as to make the participants to re-think their opinion in spite their majority status. On the other hand, females were penalised by showing anger which reduced the persuasiveness of their messages.

These lines of studies suggest that it is worthwhile to further examine participants' perceived happy, anger, appropriateness of emotions displayed by the confederates and their uniqueness of ideas when expressed by either the male or female confederates. Therefore, in this section, I examined a 3 (Conditions: happy, anger and neutral) X 2 (Gender: Female vs. Male) on perceived happy, anger, emotions' appropriateness and ideas' uniqueness by the confederates.

Manipulation check. A 3 (Conditions: happy, anger and neutral) X 2 (Gender: Female vs. Male) between subject ANOVA was ran on perceived happy ratings of the confederates. There was a main effect of condition, $F(2, 117)= 85.21$, $p<.001$. Participants who interacted with confederates in happy condition expressed significantly higher ratings of happy ($M= 6.98$, $SD= 1.22$) as compared to those participants who interacted with the confederates in the anger condition ($M= 3.64$, $SD= 1.42$), $t(80)= 11.45$, $p<.01$, and also that of confederates in the neutral condition ($M= 4.85$, $SD= 1.17$), $t(80)=8.04$, $p<.001$. Additionally, those participants who interacted with the confederates in neutral condition gave significantly higher ratings of happy than those in the anger condition, $t(80)= 4.23$, $p<.001$. There was also no main effect of gender, $F(1, 117)= .61$, $p=.44$; that is the perceived

happiness of male confederate (M= 5.11, SD= 2.20) were not different from that of females (M= 5.21, SD= 1.47) across the conditions.

There is a significant interaction of condition and gender on the perceived happy ratings of the confederate, F(2, 117)= 15.28, p<.001. This means that the perceived happy ratings of the confederates across condition depended on gender. In the neutral condition, both gender-male (M= 4.58, SD= 1.07) and female (M= 5.14, SD= 1.24), t(39)= -1.54, p= .13, were not different from each other in perceived happiness ratings. In the happy condition, the male confederate (M= 7.63, SD= .76) was perceived to be significantly happier than females (M= 6.23, SD= 1.24), t(39)= 4.41, p<.001. In the anger condition, the male confederate (M= 3.00, SD= 1.22) was perceived to be significantly less happy than female confederates (M= 4.32, SD= 1.31), t(39)= -3.36, p=.002.

Manipulation check. A 3 (Conditions: happy, anger and neutral) X 2 (Gender: Female vs. Male) between subject ANOVA was ran on perceived anger ratings of the confederates. There was a main effect of condition, F(2, 117)=142.35, p<.001. Participants who interacted with confederates in the anger condition expressed significantly higher ratings of anger (M= 4.90, SD= 2.17) as compared to those participants who interacted with the confederates in the happy condition (M= 1.34, SD= .43), t(43.12)= 10.42, p<.001, and also that of confederates in the neutral condition (M= 1.97, SD= .97), t(55.44)=7.99, p<.001. Additionally, those participants who interacted with the confederates in neutral condition gave significantly higher ratings of anger than those in the happy condition, t(54.99)= 3.81, p<.001. There was also a main effect of gender controlling for condition, males (M= 3.27, SD= 2.52) tend to express significantly higher anger than females (M= 2.19, SD= 1.31), F(1, 117)= 37.42, p<.001.

There is a significant interaction of condition and gender on the perceived anger ratings of the confederate, F(2, 117)= 35.59, p<.001. This means that the perceived anger ratings of the confederates across condition depended on gender. In the neutral condition, both gender- male (M= 2.05, SD= .99), female (M= 1.89, SD= .97), t(39)= .52, p= .60, were not different from each other in terms of perceived anger. In the anger condition, the male confederate (M= 6.55, SD= 1.31) was perceived to be significantly more angry than female confederates (M= 3.24, SD= 1.50), t(39)= 7.57, p<.001. In the happy condition, the male confederate (M= 1.29, SD= .38) was not significantly different from the female confederates in perceived anger, (M= 1.39, SD= .48), t(39)= -.73, p=.47.

Appropriateness. 3 (Conditions: happy, anger and neutral) X 2 (Gender: Female vs. Male) between subject ANOVA was ran on perceived appropriateness of emotions by the confederates. There was a main effect of condition, F(2, 117)= 38.01, p<.001. Participants who interacted with confederates in the anger condition expressed significantly lower ratings of anger (M= 5.10, SD= .91) as compared to participants who interacted with confederates in the happy condition (M= 6.10, SD= .45), t(58.72)= -6.36, p<.001, and also that of participants who interacted with the confederates in the neutral condition (M= 6.15, SD= .50), t(62)= -6.50, p<.001.The mean level of perceived appropriateness was not different in neutral than in happy condition, t(80)= -.41, p=.68. There is a main effect of gender, F(1, 117)= 8.35, p=.01, controlling for the condition, females' emotions (M= 5.94, SD= .60) tend to be perceived as more appropriate than male's emotions (M= 5.63, SD= .95).

There is a significant interaction of conditions and gender on the perceived appropriateness ratings of the confederate, F(2, 117)= 5.63, p=.01. This means that the perceived appropriateness ratings of the confederates across condition depended on gender. In the neutral condition, both gender- male (M= 6.07, SD= .51), female (M= 6.23, SD= .49), t(39)= -.98, p= .33 were not different from each other. In the anger condition, the male

confederate (M= 4.68, SD= .93) had significantly lower appropriateness ratings than the female confederates, (M= 5.52, SD= .68), t(39)= -3.30, *p*=.002. In the happy condition, the male confederate (M= 6.12, SD= .53) was not significantly different from the female confederates in perceived appropriates of the emotions, (M= 6.09, SD= .36), t(37)= .20, *p*=.84.

Uniqueness. 3 (Conditions: happy, anger and neutral) X 2 (Gender: Female vs. Male) between subject ANOVA was ran on perceived uniqueness of the ideas expressed by the confederates. There was a main effect of condition, F(2, 117)= 10.76, p<.001. Participants who interacted with confederates in the anger condition (M= 5.80, SD= .76) expressed significantly lower uniqueness ratings of the ideas than participants in the happy condition (M= 6.31, SD= .45), t(65.08)= -3.72, p<.001, and also the participants in the neutral condition (M= 6.34, SD= .51), t(70.18)=-3.77, p<.001. Participants in the happy and neutral condition were not significantly different from perceived uniqueness of ideas, t(80)=-.25, p=.81. There is no main effect of actor's gender on perceived uniqueness of ideas, F(1, 117)= .61, p=.44. There is also no significant interaction effect of condition and actor's gender on perceived uniqueness of ideas, F(2, 117)= .81, p=.45.

Following up on the gender effect, I ran all the key hypotheses of this study controlling for gender as a key covariate. Hypothesis 1a proposed that team generative processing would be positively associated with team creativity. Team creativity was positively correlated with team generative processing, r= .24, *p*=.01, controlling for the actor's gender. Controlling for the unique opinion holder's gender and team information elaboration, team creativity was still positively correlated with team generative processing, r= .28, *p*=.002. Thus, hypothesis 1a was supported.

Hypothesis 1b proposed that team information elaboration would be positively associated with team creativity. Team creativity was positively correlated with team information elaboration, r= .14, *p*=.12, controlling for the unique opinion holder's gender. Controlling for the unique opinion holder's gender and team generative processing, team creativity was positively correlated with team information elaboration, r= .21, *p*=.023. Thus, Hypothesis 1b was supported only after adjusting for and the unique opinion holder's gender and team generative processing as covariates.

We examined hypothesis 2a again by controlling for the effect of confederate's gender. Hypothesis 2a proposed that as compared to teams with a neutral unique opinion holder, teams with a happy unique opinion holder who expresses unique ideas should achieve higher team creativity through greater team generative processing. We found an effect of contrast 1 (happy (vs. neutral)) on team generative processing, β= .90, b= 1.47, S.E.= .33, *p*<.001. Also, team generative processing also positively predicted higher levels of team creativity, β= .28, b= .13, S.E.= .04, *p*=.005. Overall, teams with a happy (vs. neutral) unique opinion holder significantly influenced team creativity indirectly through team generative processing, b= .19, S.E.= .08, 95% CI [.06, .35] (*See Figure B11*). Hypothesis 2a was supported even after controlling for the unique opinion holder's gender.

We examined hypothesis 2b again by controlling for the confederate's gender. Hypothesis 2b proposed as compared to teams with a neutral unique opinion holder, teams with an angry unique opinion holder who expresses unique ideas should achieve higher team creativity through higher team information elaboration. There was an effect of contrast 2 (anger (vs. neutral)) on team information elaboration, β= .63, b= .82, S.E.= .27, *p*=.003. Also, team information elaboration also positively predicted higher levels of team creativity, β= .20, b= .12, S.E.= .05, p=.03. Overall, teams with an angry (vs. neutral) unique opinion holder significantly influenced team creativity indirectly through team information

elaboration, b= .10, S.E.= .06, 95% CI [.009, .23] (*See Figure B11)*. Hypothesis 2b was supported even after controlling for the unique opinion holder's gender.

Controlling for the unique opinion holder's gender, hypothesis 3a proposed that there is a moderating influence of team working memory on happy (vs. neutral) unique opinion holder on team generative processing. Hypothesis 3a was not supported, as there was a non-significant interaction effect between contrast 1 and team working memory on team generative processing, b= 2.53, SE= 7.31, *p*=.73. Hypothesis 3a was still not supported after controlling for the unique opinion holder's gender (*See Figure B13*).

Controlling for the unique opinion holder's gender, hypothesis 3b proposed that there is a moderating influence of team working memory on anger (vs. neutral) unique opinion holder on team information elaboration. Hypothesis 3b was not supported, as there was a non-significant interaction effect between contrast 2 and team working memory on team information elaboration, b= 6.67, SE= 4.91, *p*= .18. Hypothesis 3b was still not supported after controlling for the unique opinion holder's gender (*See Figure B12)*.

In summary, we found that the anger expression by males tend to be perceived as stronger than that of female expression and that the anger expression is less appropriate as compared to neutral and happy expression in the context of team idea-generation. Interestingly, male's expression of anger came across as less appropriate than females for this study. Additionally, ideas expressed were deemed less unique in the anger condition as compared to both happy and neutral conditions, but it did not differ whether male or female confederates expressed it. A further exploratory analysis was ran on all hypotheses that include gender as the only covariate, we found support for several hypotheses 1a to 2b but not hypothesis 1b, 3a and 3b, a pattern of results that is similar in the main study. In the

subsequent chapter, I discuss the key findings from all of the analysis and provide practical implications for today's organizations.

Chapter 11
Discussion

At a broader level, studies that examined emotions in creative teams have tended to focus on using the same mood induction to instill a collective experience of emotions among members (De Dreu et al., 2008; Pillay et al., 2020), and rarely on the spread of discrete emotions from one member to the team. The present research unpacks a critical feature of discrete emotions of a single member on the team's information processing and team creativity. Specifically, I found that a unique opinion holder's happiness and anger would bring about team creativity using two separate and distinct information-processing pathways. Observing a unique opinion holder's happiness brought about higher team creativity through the stimulation of cognitive associations across the intersection of members' semantic networks (i.e. team generative processing). On the other hand, observing a unique opinion's anger brought about higher team creativity through more thoughtful and careful deliberation of members' expressed ideas during team discussion (i.e. team information elaboration). Therefore, in this study, I provide a nuanced understanding of how a unique opinion holder's emotion can impact team creative processes differentially through examining team executive functions.

First, I found that teams interacting with an angry unique opinion holder utilized team information elaboration to achieve higher team creativity. The present study suggests the benefits of having angry members in a team, which actually led teams to increased rigor in their processing of ideas during the discussion. This finding is consistent with more recent studies that showed that anger is persuasive in communicating a threat to others, which increases the processing of other's messages in a more thoughtful and deliberate manner (Calanchini, Moons & Mackie, 2016; Van Kleef et al., 2009) and also to perform extensive information search (Rees et al., 2019). As aligned with past negotiation studies that found

that anger tends to elicit greater cooperation from receivers and lead to greater concessions from an interacting partner (Sinaceur & Tiedens, 2006; Van Kleef, De Dreu, Pietroni & Manstead, 2006; Van Kleef, De Dreu, & Manstead, 2004), the present study found that anger is beneficial getting members to cooperate with one another in re-analyzing the problem and motivated closely scrutiny on members' inputs for higher creativity. Indeed, for some studies, anger was also recognized as a negative and destructive emotion that is likely to affectively contagious others in a team, thus leading to poorer team outcomes. Especially, when leaders behave angrily, followers tend to perceive them as being less charismatic and performed worse (Johnson, 2008; Lewis, 2000). Our study better illustrates the minority literature when anger from a member should be perceived as somewhat surprising and alarming (and perhaps inappropriate), which thwarts the group's consensus-seeking tendencies but to thoroughly think through, deliberate on the problem and members' inputs based on the points brought about by the angry member.

Second, the present study found that teams interacting with a happy unique opinion holder utilized team generative processing for higher creativity. The current finding suggests the benefit of having a happy member in a team where other members are more likely to carry less fixed mental categories such that more and multiple linkages can be drawn between disparate and distinct concepts. Therefore, these teams are adept in using generative processing for the branching out and broadening of the range of ideas expressed during group discussion (Nijstad et al., 2010; Hoever et al., 2018), thus allowing teams to derive creative benefits from the serendipitous discovery of new ideas. This finding is supported by past studies at the team level, which showed that felt happiness increased divergent and broadened one's search of information related to a decision-making problem (De Dreu, Baas & Nijstad, 2008; Fredrickson, 2003); similarly, teams are also able to tap on such cognitive activation system to increase creative insights. This finding is also consistent with the dual pathway

model proposed by Hoever et al. (2012), where team creativity is not just about sharing, discussing and integrating different members' inputs to form more novel and useful solutions (i.e. team information elaboration) but also a need to incorporate the cognitive stimulation by members' inputs to produce highly divergent outputs (i.e. team generative processing). Indeed, past studies also found that positive affect actually spurred greater cognitive effort, increased one's engagement in problem-solving and adopted advanced logical reasoning (e.g. Sullivan and Conway, 1989; Isen, 2003). The present study reconciled the inconsistencies by examining discrete emotions like happiness in a team creativity context.

Third, this study found the expression of anger to be less appropriate than the expression of happiness and neutral in an idea-generation context in teams. This finding is consistent with past studies wherein anger expression which signals hostility in the expressor (Izard, 1977) and an increased social distance between members (Heerdrink, Van Kleef, Homan, & Fischer, 2015), which violates the group norms of cohesiveness and harmony. In another study, Heerdink, Koning, van Doorn, & van Kleef, 2019 found that observing a target's anger towards another member in an ambiguous context (i.e. eating greedily from the snack platter) could fuel perception of inappropriateness of anger expression towards group members, as a result of perceived violation of autonomy standards such as fairness, reciprocity and the prevention of harm to others in the group (Graham, Haidt, & Nosek, 2009, 2011; Horberg et al., 2011). In a thirteen-weeks longitudinal study that examined naturally occurring anger and gratitude emotions among members, Delvaux, Vanbeselare and Mesquita (2015) found that anger is indeed perceived as more inappropriate and less accepted by group members at the beginning (i.e. week 1) as anger expression could disrupt the team's optimal task completion and intervene with members' motivation to contribute towards the team task. At the later stages, however, they found anger was increasingly appropriate and accepted by members in the team. Despite the inappropriateness of anger expression in our study, our

study did not find negative repercussion of anger among members that bring about negative outcomes (Staw et al., 2019). Instead, our study found the beneficial and adaptive value of the expressor's anger on team outcomes; specifically, observing anger emotions from the other member increased the propensity to elaborate and advance on each other's ideas with more relevant feedback and suggestion that increased team creativity. This finding supports existing research on how negative emotions could narrowed one's attention span that lends greater information search (Rees et al., 2019), and increased scrutiny of important issues that unravel high quality solution (De Dreu et al., 2008).

Fourth, we found that the anger expression by males tend to be perceived as stronger than that of female expression and that that anger expression is less appropriate as compared to neutral and happy expression during the generation of ideas in discussion setting. Interestingly, male's expression of anger also came across as less appropriate than females for this study. However, such differences in perceived anger between the male and two female confederates did not influence their perceived uniqueness of their ideas. This is contrary to past studies' findings that found anger expression to be more appropriate and credible for males than females (Salerno and Peter-Hagene, 2015). I propose that the strength of the confederate's emotions could play an important role in shaping the participants' perception of appropriateness. As previously pointed out that anger expression is less appropriate for this discussion setting, the stronger and more intense anger expression is likely to worsen its inappropriateness. It is likely that the male confederate expressed stronger anger expression than that of anger expressed by both female confederates. In this context, a further line of inquiry could be tested with iMotions to examine if (a) there exists significant differences in the proportion of anger and happy expression, respectively, for the male and the females' confederates, in addition (b) how the anger and happy expression influence perceived appropriateness as moderated by gender. By incorporating facial coding

technology in future research, there is huge potential to unravel how different factors may shape gender differences in facial expressions thus benefiting further stream of studies on team information-processing and higher team creativity.

Fifth, this research sought to encapsulate a fundamental aspect of teamwork where I operationalized and conceptualized the influence of working memory capacity as a team-level variable, and further examined its influence in team discussion dynamics. However, the emotions, both happy and anger, expressed by the unique opinion holder did not differentially affect team information-processing processes of (a) team generative processing and (b) team information elaboration at high or low levels of team working memory capacities. A reason is that the amount of unwanted distraction from the surroundings differs substantially from within teams to across teams due to the virtual Zoom context of this research. For instance, member A may enjoy a relatively quiet environment while member B and C had to either handle noise from the café patrons in cafes or respond to chattering from family members in the background. As the interference experienced by member B and C would be greater than that of member A, he/she would have lower ability to hold more number of unique ideas active in the mind for retrieval of other associated concepts or relevant strategies from the long term memory, even if they shared similar level of working memory capacities.

Practical implications

Teams scholars are under the pressure to provide a remedy for failure for teams to harness unique information from a unique opinion holder to generate creative outputs. The present study calls for greater attention to these emotions to the discussion and for managers and leaders to help teams to create more creative outputs through building on their dominant discussion strategies. For teams interacting with a happy unique opinion holder, the leader could provide facilitate greater team generative processing by emphasizing a lower need for

structure. This arrangement would allow members to continuously trigger off remote concepts from each other's semantic networks to come up with high divergent innovative insights. On the other hand, a team interacting with an angry unique opinion holder, the leader should provide greater structure to help teams to unravel the discrepancies between the team's current task perceptions and the angry member's expectation. For instance, Park and DeShon (2018) identified a structured discussion agenda that emphasizes the need to discuss the pros and cons of different alternatives as a means to improve the quality of group discussion. Such a structured discussion intervention would improve the team's perception of the problem perceived by the angry member, and consequently, allow teams to further deliberate and advance upon each other's inputs with more relevant feedback and suggestions.

Limitations and future research

As this study is conducted in an experimental setting, future attempts to generalize these findings in organizational settings are needed. An experimental approach was used in this study, as this approach allows for a clear identification of the causal mechanisms underlying the effects of the unique opinion holder's discrete emotions on team creativity, as well as to identify the levels of teams' engagement in team executive functions. By using random assignment of participations to different conditions, the hypotheses were rigorously and scientifically examined. Furthermore, through video coding of actual group member interactions and the use of team level information processing schemes developed by previous studies (Hoever et al., 2012; Hoever et al., 2018), our study builds on the existing studies to identify a unique contribution of a member's discrete emotional expression on team creative performance. However, in the real world environment, the length of team tenure and previous team experience might pose important boundary conditions on the influence of a target member's emotions on the team's responses. For instance, in a field study of professional

sports players, Totterdell (2000) found the mood of professional cricket players was more likely to contagiously influence other players to be of the same mood when the players were older, had more commitment to the team, and being more susceptible to emotional contagion. Additionally, members may also change their perceptions about the appropriateness of certain emotions (i.e. anger) as the group task progresses from a stage to another. For instance, Delvaux, Vanbeselare and Mesquita (2015) found that group members had greater acceptance towards other members' anger display at the later stages of the project as anger could have a synergistic benefit towards improving group performance. In spite of these situational conditions that are present in the workplace, the current study provides an informative framework for the understanding of a unique opinion holder's emotions in a team performing creative tasks. Further studies may be conducted to examine the longitudinal effect of an unique opinion holder's emotions on team information-processing and team creativity.

In a similar vein, the present study examined team working memory as a key moderator of the benefits of the unique opinion holder's happy and anger expression on team creativity through team information processing pathways. Given that team working memory is a new team-level variable proposed in the study, future studies may examine the other factors that improve upon this variable. For instance, teams that are high in reflexivity are likely to adopt more effective interactions to promote information processing as assessed by team working memory. Team reflexivity is defined as "the extent to which team members would overtly reflect upon the group's objectives, strategies, and processes in a bid to adapt better to current or anticipated environmental circumstances" (West, 1996). Highly reflexive teams have been found to engage in more active information-seeking behaviours, such that they gather information widely from different sources and different levels of accessibility, and these teams are highly skilful in processing information and ideas systematically and thoroughly (Konradt et al., 2015; West, 2000). These information-processing behaviours

exemplified by highly reflexive teams allow members to build a common understanding of task that is further enhanced by team working memory. Thus, future studies may study team reflexivity as a precipitating team climate variable that increases the team's engagement in team executive functions.

Thirdly, iMotions could be utilized in future studies to examine different hypotheses related to the EASI model. Emotions as Social Information (EASI) model posits that a member's emotions can foster emotional convergence among group members through an affective pathway or an inferential pathway. Specifically, the target's emotional expression can influence the observers' own behaviour indirectly through changes in the observer's affective reactions (Kelly & Barsade, 2001; Van Kleef et al., 2004; Van Kleef et al., 2009). Positive emotional displays tend to foster greater liking towards members and better cooperation with members (Barsade, 2002; Bartel & Saavedra, 2000) whereas negative emotional displays tend to reduce members' satisfaction with each other and bring poorer performances (Van Kleef et al., 2010). On the other hand, the inferential pathways posit that the inferences drawn from observing someone's emotions would drive the observer's behaviour (Van Kleef et al., 2009). For instance, displays of negative emotions may be inferred by others as a threatening situation that narrowed members' attention span to relevant and essential details to resolve the problems (Miron-Spektor et al., 2018; Rees et al., 2019) On the other hand, displays of positive emotions may indicate a safe and benign environment that facilitates a flexible exploration of a myriad of ideas (George & Zhou, 2002). While this study is primarily focused on the inferential pathway that guides members' behavioural dynamics in the team creativity context, the affective perspective could also be utilised to add depth to the research by examining other team indices such as team satisfaction, cohesion, etc. This stream of research builds upon the train of thought whether effective and successful team would be happy to work together over time (Basadur & Head,

2011; Pearsall & Ellis, 2006). Specifically, iMotions could provide real-time and unobtrusive measures of whether facial displays of a member's happiness would trigger members to express more positive reactions than facial displays of a member's anger.

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Appendix A

Table 1

Descriptive Statistics and Bivariate Zero-order Correlations of key variables in main study

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. UOH's anger (dummy variable)	0.333	0.473	1																	
2. UOH's happy (dummy variable)	0.333	0.473	-.500**	1																
3. Perceived happiness of UOH[a]	5.157	1.878	-.575**	.690**	1															
4. Perceived anger of UOH	2.748	2.097	.741**	-.478**	-.621**	1														
5. Perceived appropriateness of UOH	5.78	0.813	-.601**	.282**	.514**	-.709**	1													
6. Perceived uniqueness of UOH	6.148	0.637	-.392**	.181*	.363**	-.423**	.763**	1												
7. Perceived Positive affect of UOH	5.614	1.047	-0.166	.349**	.517**	-0.039	.260**	.237**	1											
8. Perceived Negative affect of UOH	2.162	0.989	.592**	-.432**	-.454**	.869**	-.661**	-.495**	0.031	1										
9. UOH's gender[b]	0.52	0.502	-0.012	0.023	-0.028	.258**	-.191*	-0.062	0.153	.187*	1									
10. Number of ideas by UOH	3.821	0.425	-0.027	0.095	0.019	0.023	0.031	0.061	0.033	0.012	0.171	1								
11. Team number of ideas	8.976	2.565	-0.128	0.135	0.110	-0.115	0.171	0.105	0.129	-0.110	.188*	.304**	1							
12. Team size	3.195	0.72	0.072	0.024	-0.035	0.069	-0.033	0.015	0.058	0.060	0.057	-0.099	.273**	1						
13. Team information elaboration	4.545	1.301	.348**	-.251**	-0.152	.272**	-0.173	-0.123	0.088	.193*	0.108	0.074	-0.040	-0.036	1					
14. Team generative processing	2.825	1.636	-.210*	.425**	.365**	-.217*	.179*	0.092	0.170	-.183*	0.022	0.008	.315**	0.081	-.217*	1				
15. Team originality	3.171	1.006	-0.103	0.112	0.141	-.262**	.231*	0.108	-0.108	-.273**	-0.056	0.005	0.176	0.044	-0.112	.285**	1			
16. Team practicality	3.988	0.915	0.142	-0.019	0.014	0.083	-0.109	-0.075	-0.100	0.073	-0.049	0.015	0.131	0.016	.341**	0.066	.183*	1		
17. Team creativity	3.579	0.739	0.018	0.064	0.105	-0.127	0.090	0.027	-0.135	-0.141	-0.068	0.013	.201*	0.040	0.135	.234**	.793**	.743**	1	
18. Team working memory capacity[c]	0.886	0.072	-.231*	-0.052	0.049	-0.146	.196*	0.143	0.018	-0.143	0.006	0.117	0.132	0.102	-0.063	0.068	.262**	-0.047	0.149	1

Note. N= 123 teams.

[a]UOH refers to Unique Opinion Holder.

[b]Actor's gender is coded as 1(Male) or 0(Female).

[C]Team Working Memory capacity is the mean level of individual members' working memory capacity

Correlation is significant at the level **p<.01, *p<.05

Table 2

Descriptive Statistics and Bivariate Zero-order Correlations of all variables in main study (part 1)

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. UOH's anger (dummy variable)	0.333	0.473	1																
2. UOH's happy (dummy variable)	0.333	0.473	-.500**	1															
3. Team extraversion	3.075	0.384	-0.128	-0.068	1														
4. Team agreeableness	3.615	0.294	-0.047	-0.028	.237**	1													
5. Team conscientiousness	3.297	0.311	-.221*	0.132	0.153	.284**	1												
6. Team neuroticism	3.113	0.356	0.061	0.048	-.294**	-.326**	-.405**	1											
7. Team openess to experience	3.437	0.353	0.073	-0.164	.343**	.241**	0.074	-.241**	1										
8. Team optimism	3.347	0.330	-0.023	-0.106	.372**	.259**	.268**	-.488**	.246**	1									
9. Team need for cognition	3.245	0.367	-0.045	-0.099	.274**	0.092	0.173	-.354**	.607**	.339**	1								
10. Team emotional susceptibility	3.407	0.325	-0.003	-0.013	0.055	0.058	-0.011	0.067	0.015	0.047	-0.118	1							
11. Team learning goal orientation	3.901	0.365	-0.135	-0.082	.303**	0.087	0.176	-.275**	.497**	.310**	.564**	0.139	1						
12. Team performance goal orientation	3.513	0.389	-0.071	-0.131	0.166	-0.157	0.064	0.027	0.123	0.086	.220*	.226*	.363**	1					
13. Team avoidance goal orientation	2.993	0.456	0.160	-0.054	-.290**	-.251**	-.192*	.249**	-.233**	-.195*	-.265**	0.129	-.340**	0.100	1				
14. Team intelligence	0.740	0.120	0.016	-0.115	-0.061	-0.136	-.200*	0.027	0.092	-0.094	0.090	-.194*	0.154	-0.030	-0.100	1			
15. Team grit	3.149	0.306	-0.119	0.005	.250**	.232**	.707**	-.311**	0.045	.228*	0.036	-0.109	0.151	0.023	-.209*	-0.132	1		
16. Perceived happiness of UOH	5.157	1.878	-.575**	.690**	0.009	0.036	.229*	-0.004	-0.080	0.005	-0.043	0.070	0.049	0.013	-0.059	-0.072	0.071	1	
17. Perceived anger of UOH	2.748	2.097	.741**	-.478**	-0.061	-0.107	-.183*	0.074	0.034	0.016	-0.046	0.032	-0.092	-0.030	0.165	-0.012	-0.158	-.621**	1

Note. N= 123 teams.

UOH refers to Unique Opinion Holder.

Correlation is significant at the level **p<.01, *p<.05

Table 3

Descriptive Statistics and Bivariate Zero-order Correlations of all variables in main study (part 2)

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18. Perceived appropriateness of UOH	5.780	0.813	-.601**	.282**	-0.004	0.138	0.097	0.069	-0.116	0.008	-0.007	0.049	0.115	0.082	-0.065	0.093	0.078	.514**	-.709**
19. Perceived uniqueness of ideas by UOH	6.148	0.637	-.392**	.181*	-0.077	0.125	0.023	0.121	-0.139	0.011	-0.060	0.012	0.076	0.015	-0.027	0.114	-0.058	.363**	-.423**
20. Perceived posiitve affect of UOH	5.614	1.047	-0.166	.349**	-0.032	-0.011	0.020	0.103	-0.067	-0.103	-0.124	0.117	-0.004	0.015	0.078	0.029	-0.069	.517**	-0.039
21. Perceived negative affect of UOH	2.162	0.989	.592**	-.432**	-0.014	-.201*	-0.122	0.051	0.012	0.037	0.000	0.123	-0.070	0.097	0.117	-0.017	-0.103	-.454**	.869**
22. Team_happy_time 1	5.602	1.071	-0.035	0.014	.280**	.244**	0.085	-.212*	0.113	.356**	0.087	0.162	.230*	.296**	-0.025	-0.100	.190*	.211*	-0.015
23. Team_anger_time 1	2.215	1.041	0.064	0.083	0.053	-0.109	-0.077	0.068	0.000	-0.087	0.018	0.126	-0.089	.231*	0.118	-0.107	-0.132	0.046	0.105
24. Team_happy_time 2	5.610	1.091	-0.109	0.047	.240**	.222*	.202*	-0.088	.246**	.226*	0.169	0.146	.214*	.211*	-0.156	-0.140	0.163	.281**	-0.078
25. Team_anger_time 2	2.017	1.020	0.117	-0.029	0.042	-.238**	-0.039	-0.045	0.086	-0.057	0.041	.215*	0.088	.333**	0.037	-0.021	-0.018	-0.023	.253**
26. Team_positive affect_time 1	4.831	0.973	-0.150	0.052	.229*	.206*	.207*	-0.174	.236**	.239**	.217*	.213*	.239**	.239**	-0.089	-0.015	.188*	.209*	0.005
27. Team_negative affect_time 1	2.519	0.901	-0.058	0.088	-0.154	-0.156	-0.143	.290**	-0.150	-.249**	-0.083	.221*	-.193*	.226*	.205*	-0.083	-.242**	0.141	0.105
28. Team_positive affect_time 2	4.702	1.147	-.189*	0.108	.257**	0.173	.238**	-0.091	.248**	.178*	0.164	.239**	.261**	.228*	-0.124	-0.066	.178*	.279**	-0.037
29. Team_negative affect_time 2	2.091	0.859	0.061	-0.014	-0.104	-.191*	-0.123	.178*	-0.036	-0.163	-0.024	.204*	-0.002	.265**	0.013	0.007	-0.163	0.044	.290**
30. UOH gender	0.520	0.502	-0.012	0.023	0.037	0.074	-0.054	0.065	0.175	-0.016	0.026	0.159	0.007	-0.167	0.090	-0.057	-0.081	-0.028	.258**
31. Number of ideas by UOH	3.821	0.425	-0.027	0.095	0.060	-0.093	0.004	-0.046	-0.106	0.007	-0.015	0.038	0.093	-0.010	0.084	0.041	0.074	0.019	0.023
32. Team number of ideas	8.976	2.565	-0.128	0.135	0.145	-0.072	0.175	-0.127	-0.106	0.115	-0.041	-0.095	.183*	0.005	0.016	0.088	.181*	0.110	-0.115

Note. N= 123 teams.

UOH refers to Unique Opinion Holder.

Correlation is significant at the level **p<.01, *p<.05

Table 4

Descriptive Statistics and Bivariate Zero-order Correlations of all variables in main study (part 3)

	M	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
33. Team size	3.195	0.720	0.072	0.024	-0.128	0.052	0.032	0.021	-0.099	0.019	-0.149	-0.054	0.020	-.213*	0.077	0.135	-0.020	-0.035	0.069
34. Team information elaboration	4.545	1.301	.348**	-.251**	0.046	0.043	-0.062	0.059	0.168	0.013	-0.024	-0.020	0.018	0.014	0.004	0.008	-0.038	-0.152	.272**
35. Team generative processing	2.825	1.636	-.210*	.425**	-0.058	-0.059	0.117	-0.015	-0.043	-0.052	-0.011	-0.008	0.100	0.001	0.049	-0.057	0.069	.365**	-.217*
36. Team originality	3.171	1.006	-0.103	0.112	0.029	0.045	0.004	-0.075	0.088	.202*	0.126	-0.108	0.070	-0.061	-0.083	0.068	0.091	0.141	-.262**
37. Team practicality	3.988	0.915	0.142	-0.019	-0.031	0.000	0.062	-0.131	-0.001	0.067	-0.092	-0.098	-0.046	-0.071	0.008	0.045	0.079	0.014	0.083
38. Team creativity	3.579	0.739	0.018	0.064	0.000	0.031	0.041	-0.132	0.060	.179*	0.029	-0.135	0.019	-0.085	-0.051	0.074	0.110	0.105	-0.127
39. Team working memory capacity	0.886	0.072	-.231*	-0.052	0.073	0.017	.207*	-.248**	0.165	0.091	.209*	-0.041	0.138	-0.131	-.228*	.331**	0.117	0.049	-0.146
40. Team reflexivity	4.846	0.767	-0.161	-0.014	0.152	0.103	0.030	-0.145	-0.002	-0.043	-0.025	0.138	0.145	-0.083	-.221*	0.054	0.035	0.147	-0.153
41. Team learning behavior	5.617	0.562	-0.161	0.034	.187*	.185*	.225*	-0.084	0.053	0.133	0.102	-0.075	0.129	-0.112	-.178*	-0.009	0.154	.223*	-.224*
42. Team efficacy	3.802	0.450	-0.141	.180*	.202*	.197*	.291**	-0.109	0.017	0.106	0.085	0.031	0.171	0.129	0.000	-0.099	0.171	.426**	-.212*
43. Team safety	3.749	0.385	-.282**	0.150	-0.045	0.155	0.122	0.016	-0.017	-0.097	-0.049	0.063	0.105	0.026	-0.080	0.039	0.003	.222*	-.353**
44. Team satisfaction	4.136	0.460	-.360**	.276**	0.074	0.154	0.151	0.028	-0.078	0.004	-0.119	-0.006	0.132	0.004	-0.158	0.026	0.109	.454**	-.486**

Note. N= 123 teams.

UOH refers to Unique Opinion Holder.

Correlation is significant at the level **p<.01, *p<.05

Table 5

Descriptive Statistics and Bivariate Zero-order Correlations of all variables in main study (part 4)

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
18. Perceived appropriateness of UOH	1														
19. Perceived uniqueness of ideas by UOH	.763**	1													
20. Perceived posiitve affect of UOH	.260**	.237**	1												
21. Perceived negative affect of UOH	-.661**	-.495**	0.031	1											
22. Team_happy_time 1	.178*	0.163	.301**	0.015	1										
23. Team_anger_time 1	-0.149	-0.124	0.014	.201*	0.045	1									
24. Team_happy_time 2	.222*	.254**	.351**	-0.028	.604**	-0.011	1								
25. Team_anger_time 2	-.220*	-.261**	0.062	.406**	0.146	.586**	0.032	1							
26. Team_positive affect_time 1	0.100	0.042	.356**	0.106	.688**	.235**	.609**	.333**	1						
27. Team_negative affect_time 1	-0.067	-0.042	0.156	.277**	0.018	.671**	0.103	.487**	.312**	1					
28. Team_positive affect_time 2	.186*	0.166	.432**	0.071	.518**	0.164	.770**	.231*	.726**	.243**	1				
29. Team_negative affect_time 2	-.209*	-.193*	0.136	.509**	0.094	.509**	0.045	.740**	.308**	.694**	.282**	1			
30. UOH gender	-.191*	-0.062	0.153	.187*	-0.002	-0.068	0.089	-0.109	0.076	-0.011	0.110	-0.036	1		
31. Number of ideas by UOH	0.031	0.061	0.033	0.012	0.095	-0.070	0.040	-0.051	-0.033	-0.062	-0.016	-0.131	0.171	1	
32. Team number of ideas	0.171	0.105	0.129	-0.110	0.027	-.241**	0.090	-0.163	-0.103	-.273**	0.073	-.205*	.188*	.304**	1

Note. N= 123 teams.

UOH refers to Unique Opinion Holder.

Correlation is significant at the level **p<.01, *p<.05

Table 6

Descriptive Statistics and Bivariate Zero-order Correlations of all variables in main study (part 5)

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
33. Team size	-0.033	0.015	0.058	0.060	-0.170	-0.148	-0.105	-0.101	-0.162	-0.080	-0.078	-0.070	0.057	-0.099	.273**
34. Team information elaboration	-0.173	-0.123	0.088	.193*	0.128	0.000	.239**	0.079	0.156	-0.042	.288**	0.057	0.108	0.074	-0.040
35. Team generative processing	.179*	0.092	0.170	-.183*	0.057	-0.076	0.126	0.026	0.027	-0.029	0.084	-0.003	0.022	0.008	.315**
36. Team originality	.231*	0.108	-0.108	-.273**	-0.030	-0.145	0.016	-0.140	-0.091	-.264**	-0.018	-.219*	-0.056	0.005	0.176
37. Team practicality	-0.109	-0.075	-0.100	0.073	-0.014	0.102	0.116	0.101	-0.051	-0.036	0.168	0.066	-0.049	0.015	0.131
38. Team creativity	0.090	0.027	-0.135	-0.141	-0.029	-0.035	0.082	-0.033	-0.093	-.202*	0.092	-0.108	-0.068	0.013	.201*
39. Team working memory capacity	.196*	0.143	0.018	-0.143	-0.005	-.257**	0.110	-0.130	0.025	-0.169	0.033	-0.171	0.006	0.117	0.132
40. Team reflexivity	.241**	.302**	.226*	-0.154	0.155	-0.075	.296**	-0.066	0.157	-0.050	.236**	-0.097	-0.068	-0.063	-0.027
41. Team learning behavior	.390**	.400**	.262**	-.231*	0.166	-0.099	.479**	-0.165	0.167	-0.098	.388**	-.238**	-0.139	-0.060	0.086
42. Team efficacy	.389**	.351**	.385**	-0.166	.316**	0.083	.452**	-0.054	.225*	0.035	.398**	-0.103	-0.131	-0.033	0.108
43. Team safety	.481**	.437**	.317**	-.403**	0.105	-0.093	.340**	-.229*	0.153	-0.122	.371**	-.205*	-0.021	0.016	0.094
44. Team satisfaction	.627**	.520**	.333**	-.459**	0.160	-0.092	.353**	-0.136	0.149	-0.123	.386**	-0.164	-0.138	-0.043	.190*

Note. N= 123 teams.

UOH refers to Unique Opinion Holder.

Correlation is significant at the level **p<.01, *p<.05

Table 7

Descriptive Statistics and Bivariate Zero-order Correlations of all variables in main study (part 6)

	33	34	35	36	37	38	39	40	41	42	43	44
33. Team size	1											
34. Team information elaboration	-0.036	1										
35. Team generative processing	0.081	-.217*	1									
36. Team originality	0.044	-0.112	.285**	1								
37. Team practicality	0.016	.341**	0.066	.183*	1							
38. Team creativity	0.040	0.135	.234**	.793**	.743**	1						
39. Team working memory capacity	0.102	-0.063	0.068	.262**	-0.047	0.149	1					
40. Team reflexivity	0.049	-0.098	-0.068	-0.071	0.073	-0.003	0.141	1				
41. Team learning behavior	0.051	0.096	-0.029	0.021	0.109	0.082	0.144	.617**	1			
42. Team efficacy	-0.047	0.106	0.082	0.035	0.101	0.086	0.008	.385**	.684**	1		
43. Team safety	-0.047	0.152	0.008	0.056	0.057	0.074	0.092	.397**	.491**	.456**	1	
44. Team satisfaction	-0.058	0.109	0.063	0.083	0.093	0.114	0.022	.318**	.589**	.586**	.716**	1

Note. N= 123 teams.

UOH refers to Unique Opinion Holder.

Correlation is significant at the level **p<.01, *p<.05

Appendix B

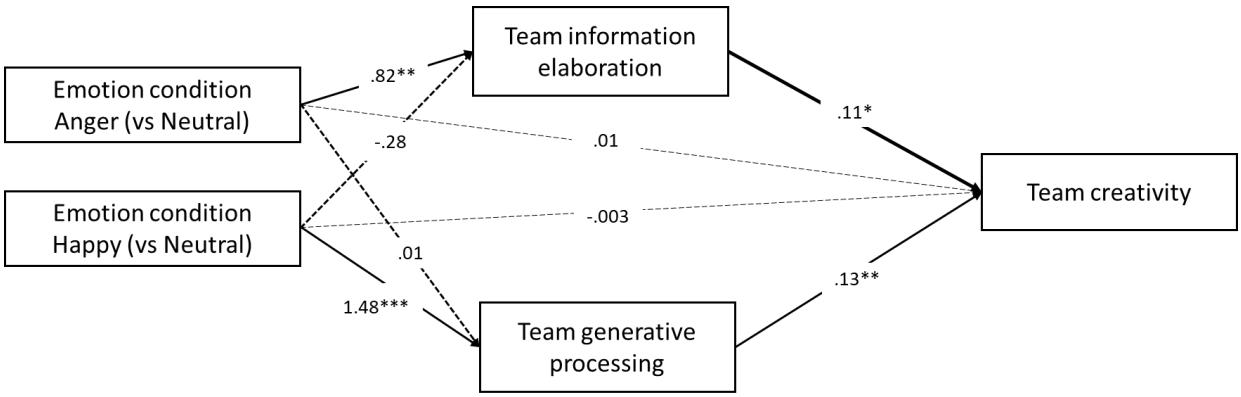

Figure 1. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team creativity that is mediated by two parallel mediators- team information elaboration and team generative processing. ***p<.001, **p<.01, *p<.05.

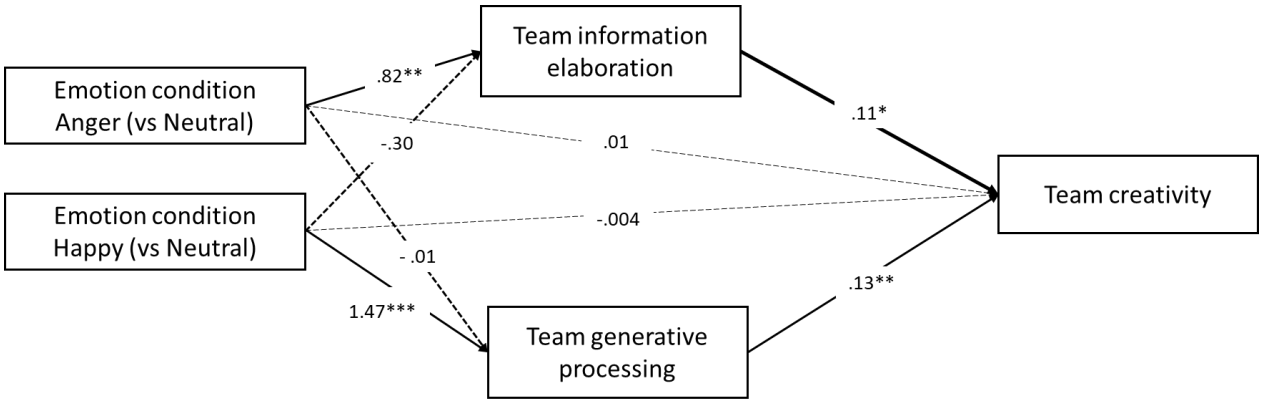

Figure 2. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team creativity that is mediated by two parallel mediators- team information elaboration and team generative processing. The (a) team size and (b) the number of ideas expressed by the unique opinion holders are controlled for in these regression paths. ***p<.001, **p<.01, *p<.05.

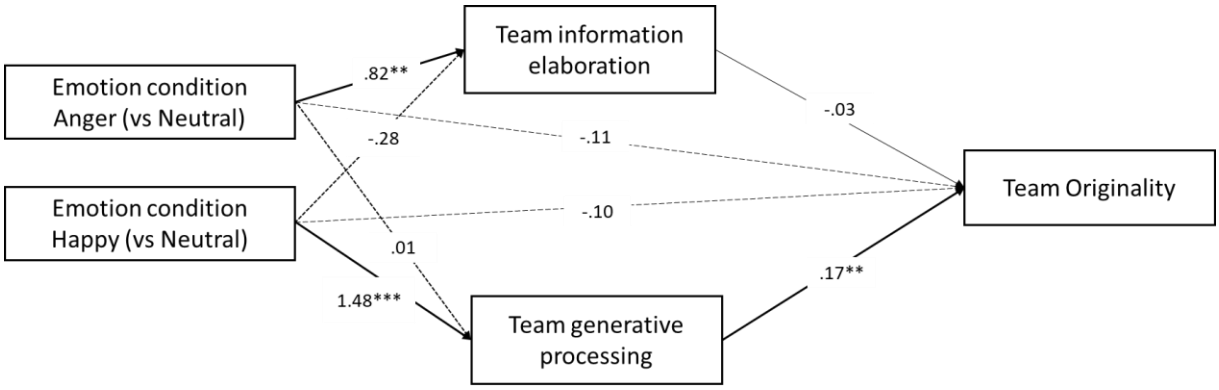

Figure 3. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team originality that is mediated by two parallel mediators- team information elaboration and team generative processing. ***p<.001, **p<.01, *p<.05.

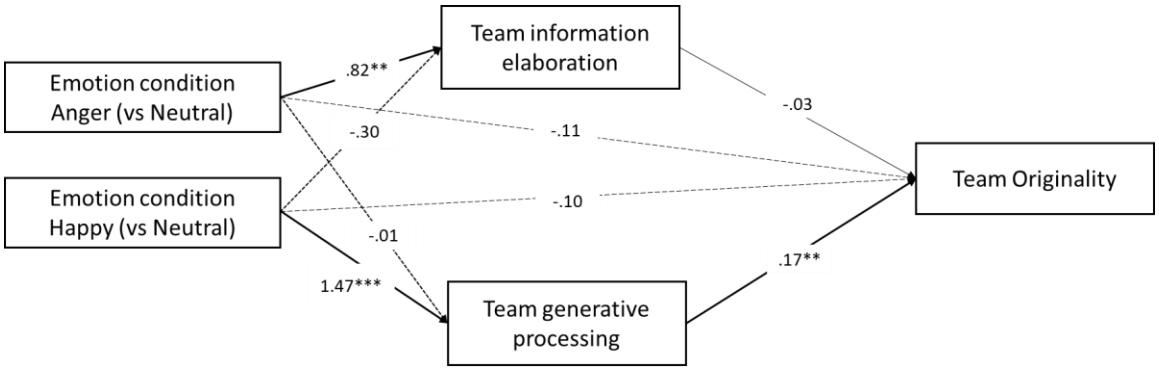

Figure 4. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team originality that is mediated by two parallel mediators- team information elaboration and team generative processing. The (a) team size and (b) the number of ideas expressed by the unique opinion holders are controlled for in these regression paths. ***p<.001, **p<.01, *p<.05.

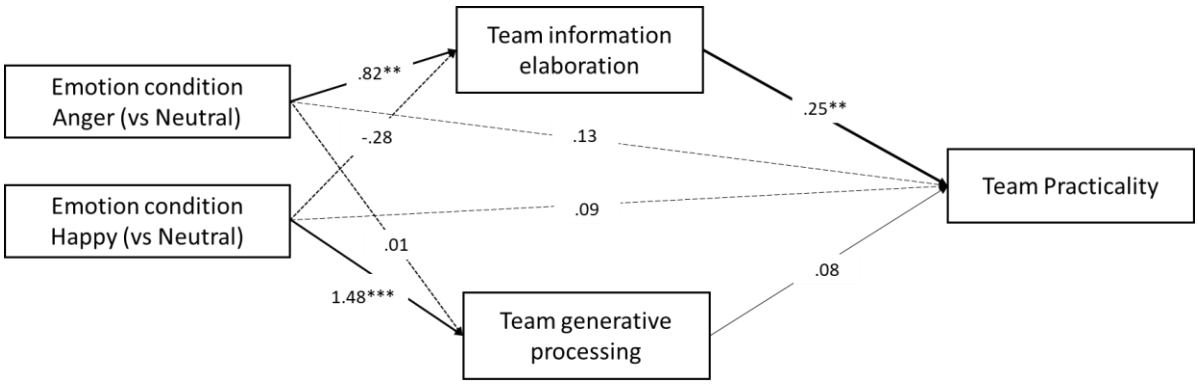

Figure 5. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team practicality that is mediated by two parallel mediators- team information elaboration and team generative processing. ***p<.001, **p<.01, *p<.05.

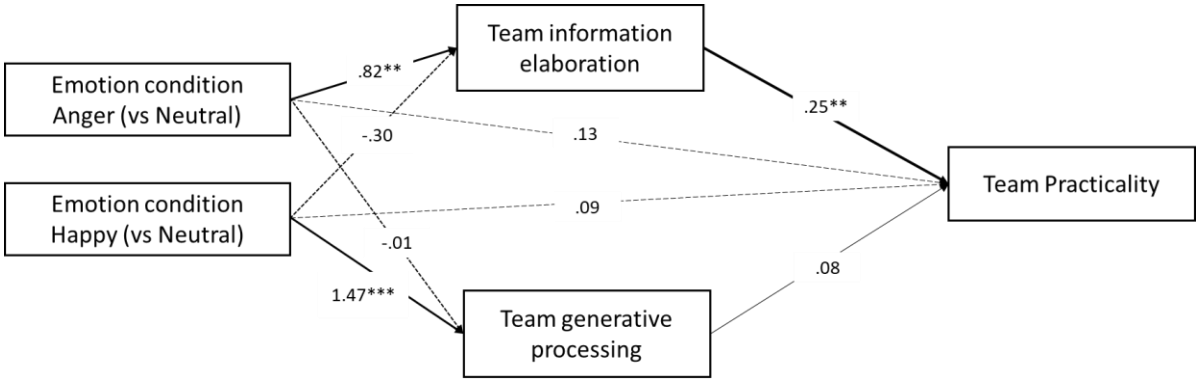

Figure 6. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team practicality that is mediated by two parallel mediators- team information elaboration and team generative processing. The (a) team size and (b) the number of ideas expressed by the unique opinion holders are controlled for in these regression paths. ***p<.001, **p<.01, *p<.05.

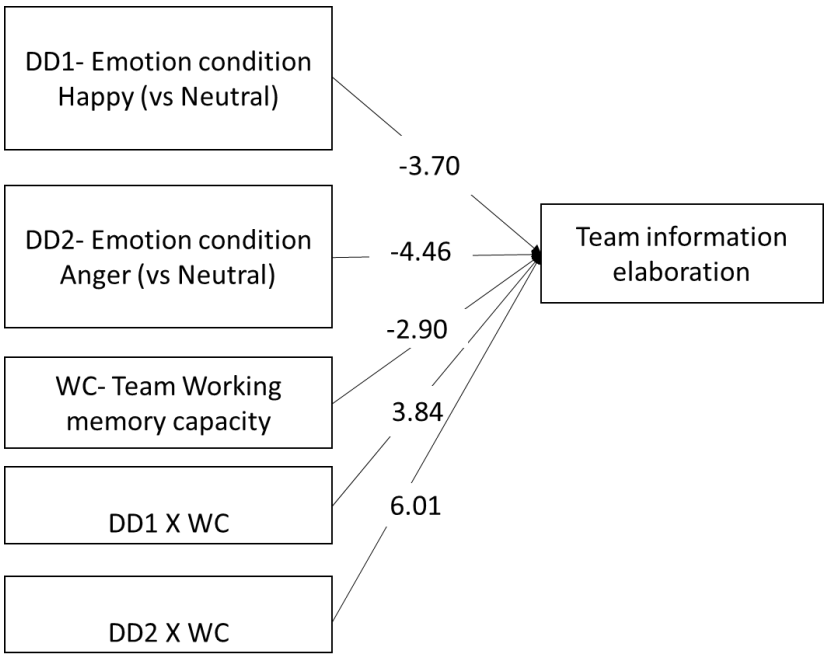

Figure 7. Regression coefficients for the interaction between emotion conditions and team working memory capacity on team information elaboration. Team working memory capacity is derived from the average of all members' working memory capacity. DD1 refers to the contrast for emotional condition happy (vs. neutral) and DD2 refers to the contrast for the emotional condition anger (vs. neutral). ***p<.001, **p<.01, *p<.05.

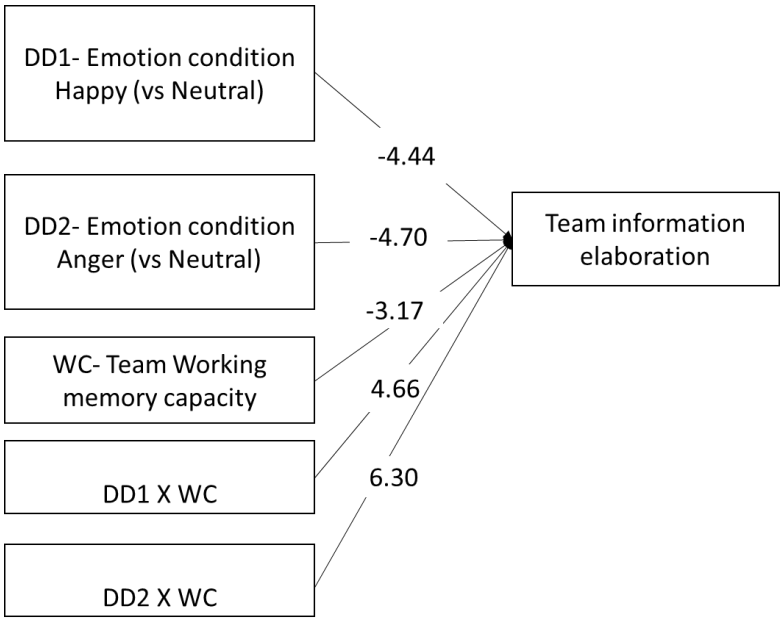

Figure 8. Regression coefficients for the interaction between emotion conditions and team working memory capacity on team information elaboration. Team working memory capacity is derived from the average of all members' working memory capacity. DD1 refers to the contrast for emotional condition happy (vs. neutral) and DD2 refers to the contrast for the emotional condition anger (vs. neutral). Team size and the number of ideas expressed by the confederates are controlled for in this interaction term. ***p<.001, **p<.01, *p<.05.

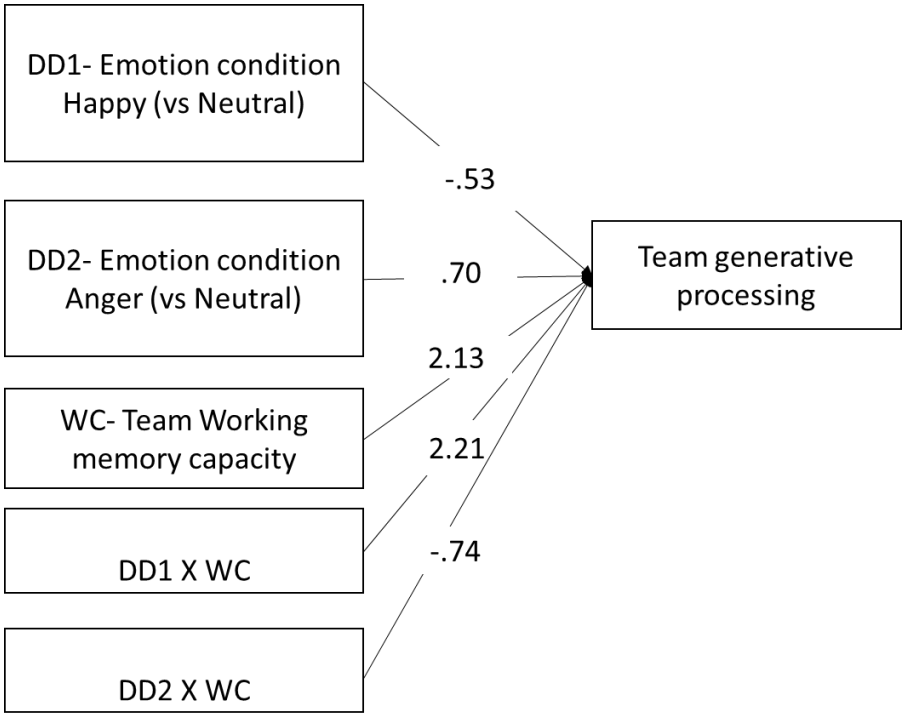

Figure 9. Regression coefficients for the interaction between emotion conditions and team working memory capacity on team generative processing. Team working memory capacity is derived from the average of all members' working memory capacity. DD1 refers to the contrast for emotional condition happy (vs. neutral) and DD2 refers to the contrast for the emotional condition anger (vs. neutral). ***p<.001, **p<.01, *p<.05.

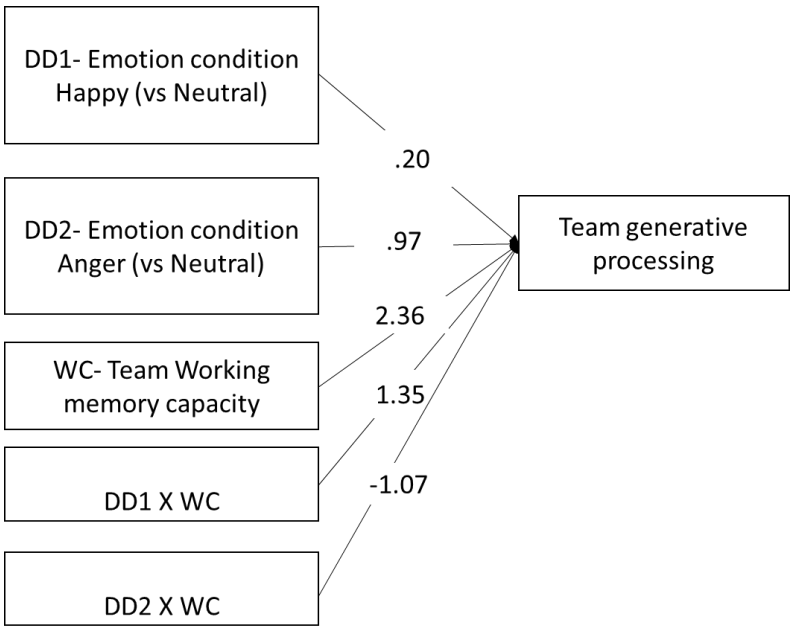

Figure 10. Regression coefficients for the interaction between emotion conditions and team working memory capacity on team generative processing. Team working memory capacity is derived from the average of all members' working memory capacity. DD1 refers to the contrast for emotional condition happy (vs. neutral) and DD2 refers to the contrast for the emotional condition anger (vs. neutral). Team size and the number of ideas expressed by the confederates are controlled for in this interaction term. ***p<.001, **p<.01, *p<.05.

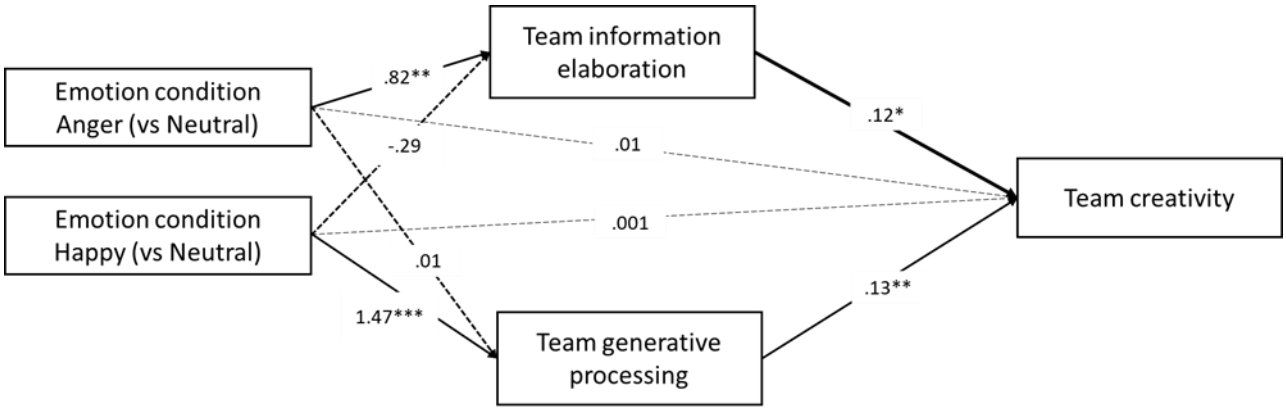

Figure 11. Regression coefficients for the relationship between emotion conditions of the unique opinion holder and team creativity that is mediated by two parallel mediators- team information elaboration and team generative processing. The gender of the unique opinion holders is controlled for in these regression paths. ****p*<.001, ***p*<.01, **p*<.05.

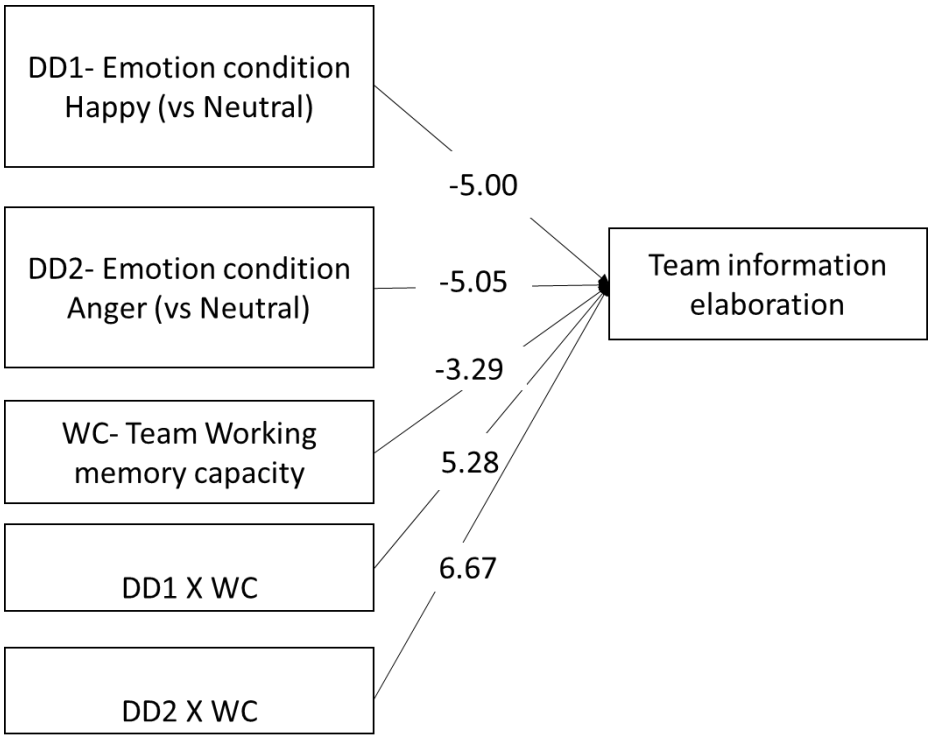

Figure 12. Regression coefficients for the interaction between emotion conditions and team working memory capacity on team information elaboration. Team working memory capacity is derived from the average of all members' working memory capacity. DD1 refers to the contrast for emotional condition happy (vs. neutral) and DD2 refers to the contrast for the emotional condition anger (vs. neutral). Gender of the confederates are controlled for in this interaction term. ***p<.001, **p<.01, *p<.05.

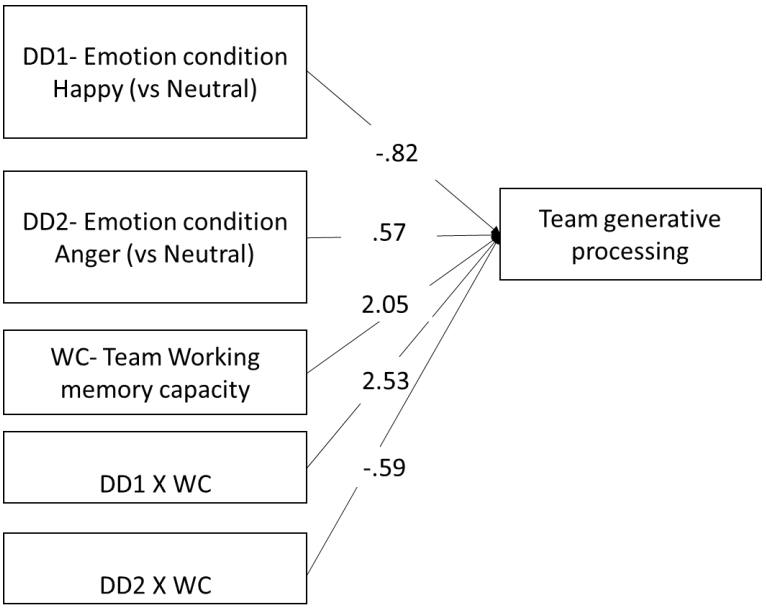

Figure 13. Regression coefficients for the interaction between emotion conditions and team working memory capacity on team generative processing. Team working memory capacity is derived from the average of all members' working memory capacity. DD1 refers to the contrast for emotional condition happy (vs. neutral) and DD2 refers to the contrast for the emotional condition anger (vs. neutral). Gender of the confederates are controlled for in this interaction term. ***p<.001, **p<.01, *p<.05.

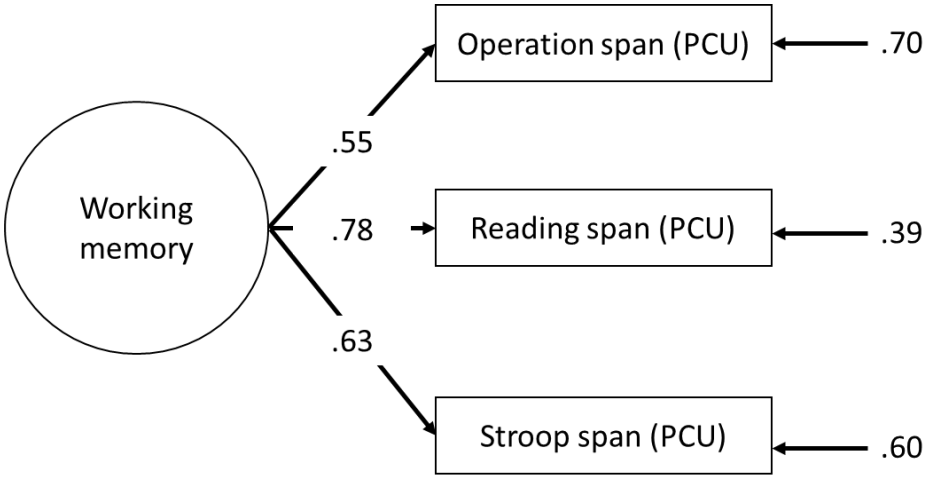

Figure 14. Measurement model of individual working memory with standardized estimates. In this diagram, the latent variables are represented by circle while the manifest variables are represented by rectangles. Long single-headed arrows signify factor loadings and short single-headed arrows indicate error variances of the manifest variables. All bolded statistics are significant at .05 level.

Appendix C
Pilot study script

The following script was used in the pilot study to test the effectiveness of the verbal content (i.e. unique ideas) that facilitated the confederates' happy, anger or neutral emotions. Participants were provided with the zoom videorecording of a confederate who shared unique ideas in a discussion setting. In order to evoke the realism of a discussion setting in the video-recording, the conversation of the confederates, including the two other fictitious members, was scripted as follows.

Member 1: How do you all think about having lessons online? How could we improve online lessons?

Member 2: I think they are great. No need to travel very far for lessons so we can have more flexibility in our schedule.

Confederate: I like online lessons as I can be more productive and do more work in the day.

Confederate: Actually I prefer to be in class rather than being online. I don't know why we need to do online lessons especially when COVID is getting better. Even though we can use emoji or the raise hand function over zoom. It is not as expressive online as it is face-to-face. If I could choose one, I would rather go for physical lesson just like those hybrid arrangements.

Confederate: I think SMU has already put in some steps to make online learning conducive for us. I just think that there is so much more thing that we should do with online learning especially with COVID around us.

Member 2: Having online lesson is something that we never got to do before. I fully support having online lessons.

Member 1: Me too, I like online lessons more. I see, shall we move on to come up with some ideas to improve online learning?

Confederate: I think the school should at least make some of the classes have VR, like the virtual reality element.

Member 1: Oh, what do you mean?

Confederate: SMU can actually work with companies, like Samsung, to provide VR tools for students to use at home. I have no idea why they haven't thought about this. SMU can actually make full use of its connection to ensure better online learning for students. For example, those in marketing can make use of VR technology to test how effective their marketing campaigns are in the virtual shopping mall

Member 2: We could also have students to do more interactive exercises, like playing games or doing pair work online rather than just listening to recorded lectures by the professors.

Confederate: I know right. Online learning should not be confined within the classroom, you know. Students can actually complete their assignments or projects at designated stations for educational purposes like in the National Museum or even the library.

Member 1: Oh okay, I think we are having more courses that are IT related and in outdoors

Member 2: I thought people would talk about how conducive it is to study at home for them. Like my neighbours, they play lot music all day. It is so distracting

Confederate: Maybe there can be some working or studying hub for those who do not have places to do their work at home.

Member 1: You mean a place like the Old SMU life building where there were so many places with fun activities to invigorate students' passion for learning?

Confederate: I was thinking more of like individual study pods with 1m spacing in between them so it is an enclosed environment with less chance of falling sick

Member 1: Oh okay, I think we are all right and the experimenter is coming in to give us the next task.

Appendix D
Main study script

The following script detailed the rationale statements and unique ideas expressed by the confederates in happy, anger or neutral emotions during the discussion. The content in the main study was highly similar to the pilot study, except that the sentences were trimmed for the confederates to express emotions in an easier way. In each discussion, the confederate started with the rationale statement for the respective condition, then followed with the unique ideas that were spaced at approximately two minutes apart.

Rationale statement

[For Neutral] I think schools, in general, have already put in some steps to prepare their students for online learning. I just think that there is so much more we should do with online learning, especially with covid right now.

[For Happy] I think schools, in general, have already put in some steps to prepare their students for online learning. I am really happy with the arrangement and I think there is also so much more we should do with online learning, especially with covid right now.

[For Anger] I mean like, I think schools, in general, have not prepared their students for online learning. This is making me really angry since there is so much more we can do, especially with covid right now.

Unique ideas

Idea 1: I think school should make at least some of the classes have VR, you know like virtual reality element. I don't know why schools have not thought about working with companies like Samsung to give VR tools to students to use at home. With this VR tool, marketing students can test how effective their marketing campaigns are in the virtual shopping malls.

Idea 2: I think… I have taken some modules that are rather difficult to simulate real life scenario. So professors can design a virtual excursion to communicate concepts to students in an easier way. Professor can create a virtual warehouse to help students taking operation management on how to manage inventory.

Idea 3: The school can design a Q&A bot manned by teaching assistants and the professor. Students can do real-time discussions with their friends and lecturers in class. It also helps profs to structure their answers better so students can understand more.

Idea 4: Not everyone has a conducive environment for studying. I think schools can consider installing study pods with 1m spacing between them in existing buildings. This is similar to the sleeping pods in our old SMU life building. Since it's a closed environment, there's less chance of falling sick.

Appendix E
Main study creativity task

For the next 12 minutes, you will be working on an idea generation task. There are no right or wrong answers. Try to generate as many high quality ideas as possible in 12 minutes.

Education landscape in Singapore is quickly evolving to include online learning as a viable long-term solution. Online learning refers to learning and socializing with peers online and outside of classroom setting. Online learning provides students with an ease of access to a diversity of topics, without being bounded by their geographical location. As Singapore strives to be the best educator in Asia, Ministry of Education (MOE) is keen to know different ways to improve online education for students in future semesters.

In the following text box, please brainstorm and type as many high quality ideas to improve online education for students in future semesters in Singapore.

For the top three teams that produced high quality ideas, those teams would receive an additional reward of $10 per member.

Appendix F

This appendix detailed all of the measures assessed in the main study.

Trait optimism

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
When things are uncertain for me in life, I usually expect the best.	○	○	○	○	○
If something can go wrong for me, it will.	○	○	○	○	○
I always look to the bright side of things in life.	○	○	○	○	○
I am optimistic about what will happen to me in the future in life.	○	○	○	○	○
In life, things never work out the way I want them to.	○	○	○	○	○
I approach my life as if "every cloud has a sliver lining".	○	○	○	○	○

Source:

Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the Life Orientation Test. *Journal of personality and social psychology*, *67*(6), 1063-1078.

Need for Cognition

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Like to solve complex problem	○	○	○	○	○
Need things explained only once	○	○	○	○	○
Can handle a lot of information	○	○	○	○	○
Love to think of new ways of doing things	○	○	○	○	○
Am quick to understand things	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Love to read challenging materials	○	○	○	○	○
Have difficulty understanding abstract ideas	○	○	○	○	○
Try to avoid complex people	○	○	○	○	○
Avoid difficult reading materials	○	○	○	○	○

Source:

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of personality and social psychology*, *42*(1), 116- 131.

Emotional susceptibility scale

	Never	Sometimes	About half the time	Most of the time	Always
Being with a happy person picks me up when I'm feeling down.	○	○	○	○	○
When someone smiles warmly at me, I smile back and feel warm inside.	○	○	○	○	○
I clench my jaws and my shoulders get tight when I see the angry faces on the news.	○	○	○	○	○
It irritates me to be around angry people.	○	○	○	○	○
I tense when overhearing an angry quarrel.	○	○	○	○	○
Being around happy people fills my mind with happy thoughts.	○	○	○	○	○

Doherty, R. W. (1997). The emotional contagion scale: A measure of individual differences. *Journal of nonverbal Behavior*, *21*(2), 131-154.

Goal orientation

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I am willing to select a challenging assignment that I can learn a lot from.	○	○	○	○	○
I often look for opportunities to develop new skills and knowledge.	○	○	○	○	○
I enjoy challenging and difficult tasks where I'll learn new skills.	○	○	○	○	○
For me, development of my ability is important enough to take risks.	○	○	○	○	○
I prefer situations that require a high level of ability and talent.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I'm concerned with showing that I can perform better than others.	○	○	○	○	○
I try to figure out what it takes to prove my ability to others.	○	○	○	○	○
I enjoy it when others are aware of how well I am doing.	○	○	○	○	○
I prefer projects where I can prove my ability to others.	○	○	○	○	○
I would avoid taking on a new task if there were a chance that I would appear rather incompetent to others.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Avoiding a show of low ability is more important to me than learning a new skill.	○	○	○	○	○
I'm concerned about taking on a task at work if my performance would reveal that I had low ability.	○	○	○	○	○
I prefer to avoid situations where I might perform poorly.	○	○	○	○	○

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Source:

VandeWalle, D. (1997). Development and validation of a work domain goal orientation instrument. *Educational and psychological measurement*, *57*(6), 995-1015.

Grit scale

	1-Not like me at all	2-Not much like me	3-Somewhat like me	4-mostly like me	5-Very much like me
I have overcome setbacks to conquer an important challenge.	○	○	○	○	○
New ideas and projects sometimes distract me from previous ones.	○	○	○	○	○
My interests change from year to year.	○	○	○	○	○
Setbacks don't discourage me.	○	○	○	○	○
I have been obsessed with a certain idea or project for a short time but later lost interest.	○	○	○	○	○
I am a hard worker.	○	○	○	○	○
I often set a goal but later choose to pursue a different one.	○	○	○	○	○
I have difficulty maintaining my focus on projects that take more than a few months to complete.	○	○	○	○	○
I finish whatever I begin.	○	○	○	○	○
I have achieved a goal that took years of work.	○	○	○	○	○
I become interested in new pursuits every few months.	○	○	○	○	○
I am diligent.	○	○	○	○	○

Source:

Duckworth, A.L., Peterson, C., Matthews, M.D., & Kelly, D.R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, *9*, 1087-1101.

PANAS time 1 and time 2

The PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent [INSERT APPROPRIATE TIME INSTRUCTIONS HERE]. Use the following scale to record your answers.

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____ interested	_____ irritable
_____ distressed	_____ alert
_____ excited	_____ ashamed
_____ upset	_____ inspired
_____ strong	_____ nervous
_____ guilty	_____ determined
_____ scared	_____ attentive
_____ hostile	_____ jittery
_____ enthusiastic	_____ active
_____ proud	_____ afraid

We have used PANAS with the following time instructions:

Moment	(you feel this way right now, that is, at the present moment)
Today	(you have felt this way today)
Past few days	(you have felt this way during the past few days)
Week	(you have felt this way during the past week)
Past few weeks	(you have felt this way during the past few weeks)
Year	(you have felt this way during the past year)
General	(you generally feel this way, that is, how you feel on the average)

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*, *54*(6), 1063-1070.

Member's evaluation of each other

I think ${q://QID1767/ChoiceTextEntryValue} is feeling the following emotions during the discussion

	1- Not at all	2	3	4	5-Moderate	6	7	8	9-Extremely Much
Happy	○	○	○	○	○	○	○	○	○
Angry	○	○	○	○	○	○	○	○	○
Upset	○	○	○	○	○	○	○	○	○
Hostile	○	○	○	○	○	○	○	○	○
Alert	○	○	○	○	○	○	○	○	○
Ashamed	○	○	○	○	○	○	○	○	○
Inspired	○	○	○	○	○	○	○	○	○
Nervous	○	○	○	○	○	○	○	○	○
Determined	○	○	○	○	○	○	○	○	○
Attentive	○	○	○	○	○	○	○	○	○
Afraid	○	○	○	○	○	○	○	○	○
Active	○	○	○	○	○	○	○	○	○

Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive and negative affect schedule (PANAS). *Journal of cross-cultural psychology*, *38*(2), 227-242.

Member’s appropriateness and uniqueness

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The member's reaction was appropriate.	○	○	○	○	○	○	○
The member's reaction was legitimate.	○	○	○	○	○	○	○
The member's reaction was justified.	○	○	○	○	○	○	○
Overall, the member produced unique ideas during the discussion.	○	○	○	○	○	○	○

Team reflexivity

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
In the team, we always look for different interpretations and perspectives to confront a problem.	○	○	○	○	○	○	○
In the team, we criticize each other's work in order to improve team effectiveness.	○	○	○	○	○	○	○
In the team, we are prepared to reflect on the way we act.	○	○	○	○	○	○	○
In the team, we engage in evaluating our weak points in attaining effectiveness.	○	○	○	○	○	○	○
In the team, we openly challenge each other's opinions.	○	○	○	○	○	○	○
In the team, we reassess any proposed solutions.	○	○	○	○	○	○	○

Source:

Carter, S. M., & West, M. A. (1998). Reflexivity, effectiveness, and mental health in BBC-TV production teams. *Small group research*, *29*(5), 583-601.

Team learning behavior

	Strongly disagree	Disagree	Somewhat disagree	Neither agree or disagree	Somewhat agree	Agree	Strongly agree
Information from team members is completed with information from other team members.	○	○	○	○	○	○	○
Team members collectively draw conclusions from the ideas that are discussed in the team.	○	○	○	○	○	○	○
Team members elaborate on each other's information and ideas.	○	○	○	○	○	○	○
Team members listen carefully to each other.	○	○	○	○	○	○	○
If something is unclear, we ask each other questions.	○	○	○	○	○	○	○
We encourage each other to look at the task from different perspectives.	○	○	○	○	○	○	○

Source:

Savelsbergh, C. M., van der Heijden, B. I., & Poell, R. F. (2009). The development and empirical validation of a multidimensional measurement instrument for team learning behaviors. *Small Group Research*, *40*(5), 578-607.

Team efficacy

	Strongly disagree	disagree	Neither agree nor disagree	agree	Strongly agree
My team is able to acheive most of the goals that we have set for ourselves in a creative way.	○	○	○	○	○
My team can overcome many challenges creatively.	○	○	○	○	○
As compared to other teams, my teams can do most tasks very creatively.	○	○	○	○	○
Even when things are tough, my team can perform quite creatively.	○	○	○	○	○

Source:

Wang, X., Li, H., & Yin, H. (2020). Antecedents and consequences of creativity in teams: When and how leader humility promotes performance via team creativity. *The Journal of Creative Behavior*, *54*(4), 843-856.

Team psychological safety

	Strongly disagree	disagree	Neither agree nor disagree	agree	Strongly agree
Members of this team are able to bring up problems and tough issues.	○	○	○	○	○
People on this team sometimes reject others for being different.	○	○	○	○	○
It is safe to take a risk on this team.	○	○	○	○	○
It is difficult to ask other members of this team for help.	○	○	○	○	○

Source:

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative science quarterly*, *44*(2), 350-383.

Team satisfaction

	Strongly disagree	disagree	Neither agree nor disagree	agree	Strongly agree
All in all, I am satisfied with my team.	○	○	○	○	○
In general, I don't like my team.	○	○	○	○	○
I am satisfied with the friendliness of my team members.	○	○	○	○	○

Source:

Hackman, J. R., & Oldham, G. R. (1975). Development of the job diagnostic survey. *Journal of Applied psychology*, *60*(2), 159-170.