Linking self-efficacy and decision-making processes in developing soccer players

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Abstract

Objectives: In sports, adults with high self-efficacy have been shown to select their first option as the final choice more often in a dynamic decision-making test. Addressing the link between self-efficacy and decision making early in age could benefit the developmental potential of athletes. In this study, we examined the link between developing players' decision self-efficacy and their decision-making processes comprising option generation and selection. Further, we explored the effect of time pressure on developing athletes' decision making. *Design:* Developing athletes (N = 97) of two different age groups were asked to report their self-efficacy and to perform a dynamic decision-making task, in which time pressure was experimentally manipulated. *Method:* 48 younger (M_{age} = 8.76, SD = 1.15) and 49 older (M_{age} = 12.18, SD = 0.87) soccer players participated. Participants were randomly presented with video scenes of soccer match play. At the point of temporal occlusion, participants generated options about the next move. After generation, participants selected among the generated options their best option and indicated their decision and motor confidence. *Results:* The self-efficacy of developing players was neither related negatively to dynamic inconsistency nor positively to option or decision quality, but self-efficacy was positively related to motor confidence in the best option. Further, time pressure improved option and decision quality. *Conclusion*: Decision-making processes have been scrutinized by showing that developing players' self-efficacy links to their motor skills rather than to their cognitive evaluation and by specifying the adaptation to time pressure. Thereby, results extend current theorizing on decision making.

Keywords: ecological rationality; children; option generation; time pressure; Take-the-First heuristic

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Have you ever watched a young soccer player attacking an opponent's defensive line having to decide what to do next? In a dynamic situation like this, making a decision is a hard task, because the options considered are constrained by several factors; not just by the limited time available, but also by the decision maker's belief in their own skill to execute potential options successfully or the estimated success of these options. A person's belief in his or her abilities to solve a task or master a situation successfully has previously been termed self-efficacy (Bandura, 1977); believing in one's ability to come up with good options and to make an adequate decision is therefore coined decision self-efficacy (Hepler & Feltz, 2012b). The subjective estimation of the success of a decision is referred to as decision confidence (Hepler & Feltz, 2012b). As the individual player's decisions have important consequences for the ongoing game, being sure about one`s own skills and about the success of an option might, therefore, impact decisions in sports. While the link between self-efficacy and decision-making processes comprising option generation and selection has been previously studied in adults (Hepler & Feltz, 2012b), this link is poorly understood in young, developing athletes. In the present study, we examined how developing athletes generate and select options in a time-pressured sports task, and how their self-efficacy relates to these decision-making processes.

In an earlier study, Hepler and Feltz (2012b) studied the relation of self-efficacy and decision-making processes in 72 basketball players between the age of 18 and 30 years. Theoretically, the authors predicted decision-making processes based on the Take-The-First (TTF) heuristic, because it is a cognitive model that explains option generation and selection of athletes in sports situations (Johnson & Raab, 2003; Raab, 2012; Raab & Johnson, 2007). The TTF claims that in familiar, yet ill-defined tasks, decision-makers generate few (i.e., two to three) options rather than generating all possible ones and select the first option rather than comparing all subsequent options deliberatively (Johnson & Raab, 2003). Methodologically, based on the TTF heuristic, the total number of options generated, the order in which the options were generated, the quality of the options generated and selected, and whether or not the first option was selected as best option are relevant outcome measures (Johnson & Raab, 2003). The mismatch of the first option generated and the final decision is called dynamic inconsistency. Dynamic inconsistency is measured as the frequency with which the first option is *not* selected to be the final choice (Johnson & Raab, 2003; Raab & Johnson, 2007). As dynamic inconsistency reflects a doubt in the first option, it is likely to link to self-efficacy and to be affected by developmental changes. Theoretically addressing the link of self-efficacy and decision making, Hepler and Feltz (2012b) argued in line with Bandura (1997) that people with higher self-efficacy will be more likely to consider fewer options and rely more on their first, intuitive option. This theoretical reasoning made the TTF heuristic a likely candidate to derive predictions.

Empirically it has been shown that players with higher self-efficacy indeed selected the first option as best option more often (i.e., lower dynamic inconsistency), generated and selected better options and did so at a higher speed. These findings have been replicated in another study with adults using a basketball task (Hepler, 2016). In another study self-efficacy was not related to decision-making performance in a softball task (Hepler & Chase, 2008). Furthermore, self-efficacy has also been shown to be positively related to decision confidence in the best option (Hepler, 2016; Hepler & Feltz, 2012b). While self-efficacy reflects the a-priori belief in what people estimate they are able to do, decision confidence refers to the subjective confidence rated for the decision after it has been made (Hepler & Feltz, 2012b). To complement decision confidence, which is a rather cognitive construct, we also assessed motor confidence. Motor confidence refers to the subjective estimation of one's own ability to execute a generated option. In the present study, we have addressed motor confidence in addition because in a game situation in sports it is crucial whether a player will be able to play a respective option (Bruce, Farrow, Raynor, & Mann, 2012).

Linking Self-Efficacy and Decision-Making Processes

We argued above, while the relation between self-efficacy and sports decision making has been addressed in adults (Hepler & Chase, 2008; Hepler & Feltz, 2012a), not much is known in developing athletes. Studying this relation in developing athletes is important for several reasons. First, self-efficacy has been shown to change during childhood and to be an important precursor of aspirations and career trajectories (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). Whether children judge themselves to be efficacious in sports is therefore also important for their future sports career (Chase, 2001; Sæther & Mehus, 2016). In particular, children's self-efficacy has been associated with their decision to participate in sports (Chase, 2001). Furthermore, decision making has also been shown to be an important component of expert performance (Mann, Williams, Ward, & Janelle, 2007) and differentiated between skilled and less-skilled players already at a young age (Ward & Williams, 2003). Thus, addressing the relation of self-efficacy and decision making in young athletes might promote important insights for talent identification and development programs. More specifically, we speculate that a greater focus on talented athletes' self-efficacy and decision-making processes early could inform how feedback is provided or instructions are given during training (cf., Buszard, Farrow, & Kemp, 2013) which ultimately may positively affect their developmental potential and benefit their sports career (Bandura et al., 2001; Chase, 2001). Lastly, targeting the relation between self-efficacy and decision making from a developmental perspective allows specifying on a theoretical level the role of person-level variables (i.e., self-efficacy, age) for successful decision making that has not been previously considered in sports research.

To predict the relation between children's self-efficacy and decision-making processes in sports, it is important to specify the underlying mechanisms. Theoretically, we assume that for the linkage between self-efficacy and decision-making processes previous experience plays an important role: The main source of self-efficacy stated by Bandura (1977) is mastery experience, meaning the degree of success one has had performing similar tasks will influence one's belief in oneself. Similarly, according to Raab and Johnson (2007): "Extensive experience of the decision-maker in the relevant environment" (p. 159) is also relevant for using decision strategies like TTF because experiencing familiar situations repeatedly will foster the selection of the first option generated. Taken together, positive experience with making decisions will promote a higher self-efficacy and make selecting the first as best option more likely (i.e., decrease dynamic inconsistency). This is why self-efficacy can be expected to link to the decision-making process via dynamic inconsistency. Empirically, however, this link is not well tested in developing athletes so far. To make specific predictions of how children's self-efficacy is linked to their decisions in sports, age-related differences in self-efficacy and decision making, especially under limited time, need to be considered.

Self-Efficacy in Developing Athletes

In sports, the self-efficacy and performance relation has been quantified in a meta-analysis (Moritz, Feltz, Fahrbach, & Mack, 2000). Within the meta-analysis, 45 studies were included yielding 102 correlations and demonstrating an average moderate correlation of .38 between self-efficacy and sports performance across all studies. However, the meta-analyses of Moritz and colleagues (2000) included only participants older than 15-years of age and age-related differences have not been addressed.

So far, only few studies have looked at self-efficacy in children in sports and physical activity (Chase, 2001; Chase, Ewing, Lirgg, & George, 1994; Lee, 1982; Lirgg & Feltz, 1991).

While research has focused on the effects of equipment modifications (Chase, Ewing, Lirgg, & George, 1994) or differently skilled role models (Lirgg & Feltz, 1991) on children's self-efficacy in sports, only one study has examined age differences in self-efficacy (Chase, 2001). A study with 8- to 14-year old children revealed that children with high self-efficacy chose to participate more and had higher future self-efficacy than children lower in self-efficacy (Chase, 2001). Furthermore, children with higher self-efficacy more often attributed failure to luck, while children with lower self-efficacy attributed failure to themselves, namely as a lack of ability. Importantly, younger children (8-9 years) demonstrated higher self-efficacy as compared to the older children (10-14 years; Chase, 2001). These age differences can be explained by achievement motivation theory, suggesting that as children get older, they will differentiate concepts such as ability, task difficulty, and effort (Nicholls, 1984). While children under the age of 11 years were reported to be only partially able to differentiate between these concepts, children from the age of 11 years can typically differentiate ability and effort (Nicholls, 1984).

Developing Athletes' Decision Making Under Time Pressure

The decision-making processes of developing athletes have been examined in a few sports studies (for a narrative review see Marasso, Laborde, Bardaglio, & Raab, 2014). For instance, in soccer, Ward and Williams (2003) compared sub-elite and elite soccer players between the age of 9 and 17 years in a dynamic, soccer-specific video-based decision task. Results revealed that older players as compared to their younger counterparts demonstrated superior decision-making skills (i.e., key-players highlighted and non-key-players not highlighted) improved with age. In particular, sub-elite players improved significantly with increasing age, while all age groups of elite players showed high performance. Another study from McMorris, Sproule, MacGillivary, and Lomax (2006) assessed decision making of children between the 11 and 15 years of age using a paper-based, soccer-specific task. Results indicated that decision-making performance increased with age, with 15-year-olds selecting better options than 13-year olds, and 13-year-olds performing better than 11-year-olds. To sum up, empirical evidence suggests that, among the developing players, older players make better decisions than younger players.

Although time pressure is a real demand in sports and other real-life decision-making situations, option generation and selection under limited time have rarely been studied in sport (Belling, Suss, & Ward, 2015a). For explaining and predicting effects of time pressure on decision making, ecological rationality can serve as a starting point (Todd, Gigerenzer, & ABC Research Group, 2012). Ecological rationality assumes that cognitive strategies adapt to the situation at hand, such as to time pressure during a soccer attack. In particular, strategies that better ‘exploit’ the situation and adapt to the situational constraints are likely to lead to better decisions. Accordingly, simpler strategies that require the use of less information or fewer mental processes are likely to be better suited to time-constrained tasks than those more complicated (i.e., that require more information or processes). Based on the general assumption that “less-is-more” (Todd et al., 2012), ecological rationality would predict that time pressure should reduce option generation and, by making decision makers more selective, leading to the generation and selection of better options.

To the best of our knowledge, there are no studies that have examined the influence of time pressure on children’s decision-making processes in sports. In a study on children’s information search, time-pressure effects were examined using a static task (Davidson, 1996): Second and fifth-grade children were asked to select pieces of information from a board that they considered relevant for choosing between objects. Although time pressure promoted faster searching of information in both age groups, the search was not limited or more selective. That children employed the same search process but at speed when the time was limited in a static task, might not transfer to generating options in a dynamic task. In a sample of adult players using a dynamic soccer decision-making task, Belling and colleagues (Belling et al., 2015a; Belling, Suss, & Ward, 2015b) demonstrated that time pressure reduced the total number of options generated. Time pressure affected highly skilled and less skilled players alike (Belling et al., 2015a), indicating that in response to time pressure players limited their generation by stopping earlier irrespective of their level of experience. To further understand the impact of time pressure on individual decision-making processes in sports, we tested how developing players respond to time pressure in a dynamic decision-making task.

The Present Study

The present study aimed to further understand decision-making processes of developing athletes by studying the link between their self-efficacy and option generation and selection. Further, we explored the impact of time pressure on these decision-making processes. Thus, we tested developing soccer players of different age: That is, we enrolled a younger (Under-11 years) and an older (Under-14 years) age group based on the studies presented above (cf. Chase, 2001) and because these age groups correspond to the age structure of professional youth academies in soccer (younger: Youth Foundation, older: Youth Development).

In detail, we predict that older players will report lower self-efficacy than younger players (Chase, 2001; Nicholl, 1984) and demonstrate better decision making (Davidson, 1996; McMorris et al., 2006; Ward & Williams, 2003). In particular, we expect older children to generate options faster as well as to generate and select better options as compared to younger players. Based on the theoretical reasoning on the relation of self-efficacy and decision making presented, we expect developing soccer players high in self-efficacy to show less dynamic inconsistency (Bandura, 1997; Johnson & Raab, 2003). Furthermore, based on the mixed empirical result obtained with an adult sample (Hepler & Chase, 2008; Hepler & Feltz, 2012a, 2012b), we will explore the relation of self-efficacy to option and decision quality as well as to generation time in developing soccer players. Lastly, we expect developing soccer players' self-efficacy to be positively related to their decision and motor confidence.

Further, regarding the impact of time pressure on developing players' decision making, our predictions are more exploratory and interactions with age are unknown. Derived from the empirical results of Belling and colleagues (2015a) obtained with an adult sample and the theoretical notion of ecological rationality, we expect time pressure to foster simple, intuitive decision-making strategies in developing players. In detail, with time pressure we expect both age groups to generate fewer options, generate options faster, generate and select options of higher quality and to select the first to be their best option more frequently (i.e., lower dynamic inconsistency) as compared to no time pressure.

Method

Participants

Using G-Power (Faul, Erdfelder, Buchner, & Lang, 2009), a sample size of n = 46 participants was estimated a-priori (α = .05, $1-\beta$ = 0.80, r = 0.36 being the lowest effect size in the study of Hepler & Feltz, 2012b) and so we aimed to recruit n = 46 players per age group. Ninety-seven male soccer players participated in this study. All participants were recruited from a German first-division soccer academy and, therefore, they can be considered experts relative to their young age (Swann, Moran, & Piggott, 2015). The mean age was 10.50 years (*SD* = 1.99, *Md* = 10.67) and the players had a mean soccer experience of 6.15 (*SD* = 2.26) years. The players were part of a larger project investigating the development of young expert soccer players. Of the N = 97 players, n = 49 played in the Youth Development teams (Under-14 teams), had a mean age of 12.18 (*SD* = 0.87) and mean starting age of playing soccer of 4.53 years (*SD* = 1.58). The n = 48 players of the Foundation teams (Under-11 teams) had a mean age of 8.76 (*SD* = 1.15) and mean starting age of playing soccer of 4.21 years (*SD* = 1.10). The two age groups did not differ regarding the mean age they started to play soccer at, $t(93) = 1.14$ [CI 95% = -0.87; 0.23], $p = .258$, $d = 0.23$.

Material

Questionnaires: Decision self-efficacy scale in soccer.

Decision self-efficacy was assessed using a 10-item questionnaire. Based on Bandura's (2005) guidelines and the soccer-specific self-efficacy scale (Gerlach, 2004), a domain-specific decision-making self-efficacy scale related to soccer was administered. Participants were asked to rate their beliefs in their ability related to soccer-specific situations (e.g., I see well-positioned teammates). In detail, in the standardized instruction participants were prompted to refer to their own ability and indicate whether they are able to do what was described in the items. Participants had to answer on a ten-point Likert-scale ranging from 1 = *not at all* to 10 = *totally* (cf., Gerlach, 2004). Internal consistency of the scale was good (Cronbach's $\alpha = .84$).

Decision-making test: option generation and selection.

The decision-making test used is based on validated test and stimulus-material by Belling and colleagues (2015a) that has been adapted to match the children's capabilities. Video scenes of live soccer match play were presented using a temporal occlusion method ($N = 21$, $n = 3$ practice, $n = 18$ test): After a short display of buildup play, the scenes suddenly stopped right before the player in possession of the ball had to make a decision. The videos stopped and held on with a frozen-frame, which gave the children time to generate their options directly marking them onto the field via touch-pad. For marking the options, children were asked to start with their finger at the position of the ball and to draw a line ending at the final position of the action (Belling et al., 2015a). For each situation presented in the video trials, a maximum of six options could be generated. Limiting the option space to six potential options resulted from a pre-evaluation of the video scenes by two expert coaches.

Manipulation of *time pressure* was within-subjects. For nine out of 18 trials, no time pressure was administered, giving the children 30 seconds to generate options via the touch-pad. In the other nine trials, participants were given 7.5 seconds (s) to generate options because results of the pilot testing indicated this time frame to produce appropriate pressure compared to 10 or 5 s. The split-half reliability of the total test was good, indicated by the Spearman-Brown coefficient for the total number of options (Spearman-Brown = .87). Good internal consistency for both video sets of the time-pressure manipulation (time pressure: α = .79, without time pressure: α = .84) further supported the reliability of the test.

All 18 video scenes were presented randomly, irrespective of the time-pressure condition. For each condition, the software automatically stopped the option generation phase after the defined time frame respectively. After generating options, participants were asked to select, out of the options they had generated, their personal best option. Therefore, participants were shown a picture of the last frame with, depicted and numbered on the field, the options they had marked during the option-generation phase before. Based on the best option selected, *dynamic inconsistency* rates were computed as the relative frequency that the first option was *not* selected by the player to be their personal best option.

After the participants had generated options and selected their best option, they were asked to rate their *decision confidence* and their *motor confidence* for each generated option in the order the options have been generated. First, decision confidence and, second, motor confidence was rated for an option before the next option was rated. For *decision confidence*, participants were asked “How good do you think this option is?” and for *motor confidence* they responded to “Are you able to play this option?”. For both confidence ratings, participants rated on a 10-point Likert-scale ranging from 0 (decision confidence: ‘not good at all’, motor confidence: ‘not at all’) to 9 (decision confidence: ‘very good’, motor confidence: ‘very well’) how confident they were in this option. Thereby, decision and motor confidence in the first option generated and best option selected were computed. *Decision and motor confidence in the first option* is relevant to analyze the link of confidence and the option-generation process (cf., Johnson & Raab, 2003) and was therefore considered in addition to confidence in the best option. Correlational analyses revealed that decision confidence and motor confidence were positively related to a medium or to a high degree (younger age group: *r* ranging from .466 to .644; older age group: *r* ranging from .562 to .742).

Procedure

Before the start of the study, written informed consent of parents was obtained and the local ethical review board approved the study protocol [blinded for review]. Participants were tested in groups of 2 to 9 players and all sessions took place after their training session. The mean duration of sessions was 47 minutes (*SD* = 6 minutes). During the session, the players were first asked to answer the decision-making self-efficacy scale for soccer. After this, they were familiarized with the decision-making test by showing them a standardized video clip (duration: 2:51 min), and explaining in detail what they will be asked to do during the test. After the clip, they were allowed and encouraged to ask open questions before the decision-making test started. The experimental procedure was presented on a XORO 9W4 Windows 8.1 touchpad with a screen sized 8.9’’ (22.6 cm) and via the experimental software OpenSesame 2.9.7 (Mathôt, Schreij, & Theeuwes, 2012). Finally, they were debriefed and thanked for their participation.

Data Analyses

Coding of dependent variables

For the decision-making test, data had to be coded and aggregated before conducting exploratory analyses. As 97 participants generated options in 18 video trials, a total of 1746 best options were selected (n = 873 time pressure, n = 873 no time pressure). In a first step, across all videos, the total *mean number of options* (18 videos) and the mean number of options per pressure conditions (9 videos time pressure vs. 9 videos no time pressure) were conducted for each person. In the same way, the *frequency of best option* across all videos was calculated for each possible option (1–6) in a second step. Furthermore, the *generation time for the first option* one was calculated as the mean generating time for the first option, which was calculated from the onset of the occlusion to the offset of marking the first option.

To evaluate *option quality* for the options generated and selected, two experienced youth soccer coaches were recruited. Both coaches had a UEFA B-level coaching license and at least 10 years of experience coaching a youth soccer team. The coaches were blind to the experimental hypotheses and independently rated all options the players had generated for the 18 test trials, presented in random order, on a 10-point scale (from 1, ‘not at all good’, to 10, ‘very good’). Based on good interrater agreement for the best option (intraclass correlation coefficient [ICC] = .77, $p < .001$) and for the quality of all options (ICC = .67, $p < .001$), a quality score for each generated option was computed by calculating the average of the coaches’ quality ratings. Thereby, option quality was obtained for each option and the best option selected.

Exploratory data analyses. Missing values and outliers were examined via boxplots, histograms, and z-scores. Missing values and outliers were not replaced, because missing values were less than 1% and no outliers (> 3 SD) were apparent (Tabachnick & Fidell, 2007). After the inspection of the Q-Q and P-P Plots and because of the central limit theorem that should hold for the sample sizes > 40 (Tabachnick & Fidell, 2007), a normal distribution of the parameters could be inferred for the sample of *N* = 97 within the present study. Thus, parametric tests were conducted that will be labeled in the respective result sections. For all statistical analyses, the level of significance was a priori set at $\alpha = .05$.

Results

Relation between Self-Efficacy and Decision-Making Processes

The developing soccer players indicated a mean decision self-efficacy of 6.41 (*SD* = 1.33). As expected, decision self-efficacy was negatively correlated with age, $r = -.325$, $p < .001$, and the group of younger players had a significantly higher decision self-efficacy (*M* = 6.90, *SD* = 1.27) than the older players (*M* = 5.94, *SD* = 1.24), $t(94) = 3.73$ [CI 95% = 0.44; 1.46], $p < .001$, $d = 0.77$. Based on the age difference and significant correlation of age and decision self-efficacy, age was partialed out in the subsequent correlational analyses (see Table 1 for all correlations; only significant correlations will be reported in the text because of readability[1]).

Regarding the link of decision self-efficacy and the decision-making process variables, partial correlations showed that for the younger and older age group of players decision self-efficacy was neither related to the total number of options generated with and without time pressure, nor to the quality of the first option generated with and without time, or to the quality of the best option selected with and without time pressure. Furthermore, in both age groups, decision self-efficacy was not related to the generation time of the first option and dynamic inconsistency with time pressure. While in the older players decision self-efficacy was not significantly related to the generation time of the first option or dynamic inconsistency without

[1] Conducting the same correlational analyses and partialing out the soccer starting age yielded the exact same pattern of results (i.e., direction and size of correlations).

time pressure, without time pressure younger players generated first options faster (younger players: *r* = -.298, *p* = .045) and showed higher dynamic inconsistency (younger players: *r* = .334, *p* = .023) the higher their self-efficacy was.

Deviating from predictions self-efficacy was not related to decision confidence but was positively related to motor confidence. In detail, in both age groups self-efficacy was neither related to decision confidence in the first option generated with and without time pressure, nor to decision confidence in the best option generated with and without time pressure. The correlation of decision self-efficacy and motor confidence in the first option generated without time pressure was only marginally significant (younger players: *r* = .282, *p* = .058; older players: *r* = .257, *p* = .078). With time pressure younger (*r* = .295, *p* = .047) and older players (*r* = .328, *p* = .023) were more confident in their ability to execute the first option generated the higher their decision self-efficacy was. While in the younger age group the correlation of decision self-efficacy and motor confidence in the best option generated with time pressure was only marginally significant (younger players: *r* = .269, *p* = 0.71), the respective correlation was significant in the older age group (older players: *r* = .343 , *p* = .017). Without time pressure, younger (*r* = .360, *p* = .014) and older players (*r* = .315, *p* = .029) were more confident in their ability to execute the best option selected the higher their decision self-efficacy was.

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Effects of Time Pressure and Age on Decision-Making Processes

To explore the impact of time pressure on young players' decision-making processes, time pressure, age and interaction effects on the number of options generated, the generation time of the first option, the quality of the first option generated, and on the quality of the best option selected were tested with a 2 (time pressure vs. no time pressure) × 2 (younger vs. older) repeated measures multivariate analyses of variance (MANOVA)[2]. While the multivariate effects of time pressure (Wilks's Lambda $\lambda = .28$, $F\,(4, 92) = 58.60$, $p < .001$, $\eta_p^2 = .72$) and age (Wilks's Lambda $\lambda = .86$, $F\,(4, 92) = 3.62$, $p = .009$, $\eta_p^2 = .14$) were significant, the time pressure × age interaction was not significant (Wilks's Lambda $\lambda = .98$, $F\,(4, 92) = 0.59$, $p = .670$, $\eta_p^2 = .03$).

Following up on the multivariate time-pressure effect, univariate results showed that all decision-making variables were affected by time pressure (see Figure 1). Players generated fewer options ($F\,(1, 95) = 133.93$, $p < .001$, $\eta^2 = .59$, $\omega^2 = .58$), first options faster ($F\,(1, 95) = 36.95$, $p < .001$, $\eta^2 = .28$, $\omega^2 = .27$), first options of higher quality ($F\,(1, 95) = 70.61$, $p < .001$, $\eta^2 = .45$, $\omega^2 = .44$), and selected best options of higher quality ($F\,(1, 95) = 66.62$, $p < .001$, $\eta^2 = .42$, $\omega^2 = .41$). Furthermore, Chi² tests indicated that in both time-pressure conditions, players selected their first option as best option in more than 50% of their decisions (time-pressure condition: $\chi^2(1, N = 97) = 182.36$, $p < .001$, Cramér's V = .46; no-time-pressure condition: $\chi^2(1, N = 97) = 149.27$, $p < .001$, Cramér's V = .49). Comparing both pressure conditions revealed that players selected their first option as best option in 70.7 % ($n = 636$) of the decisions without time pressure and in 72.9% ($n = 679$) of the decisions in the time-pressure condition, $\chi^2(1, N = 97) = 1.02$, $p = .321$, Cramér's V = .02.

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The univariate effect of age group on the individual variables revealed that option generation differed between age groups while selection did not (see Figure 1). Age groups did not differ in the quality of their option selected ($F\,(1, 95) = 3.80$, $p = .055$, $\eta^2 = .04$, $\omega^2 = .03$), but older players generated more options ($F\,(1, 95) = 5.80$, $p = .018$, $\eta^2 = .06$, $\omega^2 = .05$),

[2] Controlling for the soccer starting age in the in the 2 (time pressure vs. no time pressure) × 2 (younger vs. older) repeated measures multivariate analyses of variance by conducting a MANCOVA showed no multivariate main effect of starting age and yielded the same multivariate and univariate effects of age group and time pressure on the decision-making processes.

generated first options faster (F (1, 95) = 8.15, p = .005, η^2 = .08, ω^2 = .07) and generated first options of higher quality (F (1, 95) = 5.86, p = .007, η^2 = .07, ω^2 = .06). Furthermore, both age groups selected their first option as best option in more than 50% of their decisions (younger players: χ^2(1, N = 97) = 165.38, p < .001, Cramér's V = .44; no-older players: χ^2(1, N = 97) = 165.45, p < .001, Cramér's V = .43). Comparing both age groups revealed that the age groups did not differ in their frequency of selecting their first as best option (χ^2(1, N = 97) = 1.02, p = .321, Cramér's V = .02): Younger players selected their first option to be the best option in 71.9 % (n = 621) of the decisions and older players in 71.7% (n = 632) of the decisions.

Additional Analyses

Take-The-First heuristic

In additional analyses, we tested the predictions of the TTF heuristic in the sample of developing soccer players. Results revealed that players generated their options in a meaningful way. This was indicated by a non-random distribution of the frequency options were selected as the best option across serial positions: The first option generated was selected to be the best option more frequently in both conditions, with time pressure (χ^2(5, N = 97) = 2279.11, p < .001, Cramér's V = .72), and without time pressure (χ^2(5, N = 97) = 1968.95, p < .001, Cramér's V = .67). Also both age groups, younger (χ^2(5, N = 97) =2125.86, p < .001, Cramér's V = .70) and older players (χ^2(5, N = 97) = 1616.50, p < .001, Cramér's V = .68) selected their first as best option more frequently than options generated later. Furthermore, older (p < .001, η_p^2 = .789) and younger players (p < .001, η_p^2 = .733) generated better first options as compared to options generated at later serial positions. Overall, in relation to the order of options, this means that not all options generated were selected as the best option with equal frequency and that first options generated were of higher quality than options generated later.

Correlational analyses mainly indicated that players' decision making was more dynamically inconsistent the more options they generated: Both age groups showed higher dynamic inconsistency the more options they generated in the no-time-pressure condition (younger players: r = .391, p = .007; older players: r = .318, p = .028). In the time-pressure condition, the total number of options generated by older players was not significantly related to their dynamic inconsistency (r = .185, p = .207), but younger players selected the first option significantly less often as their best option the more options they generated (r = .491, p = .001).

Motor confidence

In additional exploratory analyses, we tested whether the serial position an option was generated at affected the players' motor confidence. A repeated-measures ANOVA with serial position as a factor showed that the players' motor confidence decreased with serial position, $F(3, 55) = 26.52$, $p < .001$, $\eta^2 = .30$. This means that players indeed felt more confident in executing options that they had generated first as opposed to options they had generated later. Additionally considering the players' motor confidence in the final decision revealed that the motor confidence in the final decision was not higher than the motor confidence in the first option (p = .143), but higher as compared to the second (p < .001) and third option generated (p < .001).

Discussion

Within the present study, we tested a theoretically proposed link of self-efficacy and decision-making processes in developing soccer players of different age. Moreover, we examined whether developing soccer players adapted their decision making to time pressure in a similar adaptive manner as adult players.

As expected, the group of younger soccer players demonstrated a higher decision self-efficacy than their older counterparts. This finding is in line with previous findings showing a decrease in self-efficacy with age in childhood (Chase, 2001). Children become aware and, hence, more accurate in their self-beliefs as they become older, which can also impact their perception of competence (Bandura, 2001; Multon, Brown, & Lent, 1991). For the developing players tested in the present study, this general age-trend might be additionally increased because of the high-performance setting, in which they are trained and receive the coaches' feedback on a daily basis (Bandura et al., 2001).

Developing Players' Self-Efficacy Was not Linked to Decision-Making Processes

Results obtained in the present study did not support the relation between self-efficacy and decision making predicted based on the study of Hepler and Feltz (2012b): In both age groups, self-efficacy was not positively related to decision-making performance. While the results are not in line with findings of Hepler and Feltz (2012b) showing a positive correlation, our findings are in agreement with studies that did not show a relation between decision self-efficacy and decision-making performance (Hepler & Chase, 2008; Hepler & Feltz, 2012a). As empirical evidence for the relation between self-efficacy and decision-making performance is mixed and studies differed not only with respect to the age groups (i.e. adults, children) tested, conclusions regarding age differences cannot be drawn directly. To scrutinize whether the self-efficacy performance relation in sports differs between adults and children, future studies are needed to compare different age groups of adults and children by using the same measure (cf., Moritz et al., 2000).

The theoretically proposed link between self-efficacy and dynamic inconsistency was not empirically supported in developing players. In detail, the present study showed no relation in older players, but younger players' self-efficacy was positively related to dynamic inconsistency. So, the higher younger players' self-efficacy the less often they selected their first as best option in the no-time-pressure condition. One potential explanation might be that, without time pressure, players are more likely to compare among options while generating also given they were provided with a frozen frame of the situation. This might, in turn, result in a decision against their first intuitive option. Interestingly, however, in the no-time-pressure condition younger players' self-efficacy was also negatively related to generation time, meaning the higher younger players self-efficacy, the faster they generated the first option and the less often they selected the first option as best option. Potentially, younger players might be aware of the speed they generated the first option at, which might make them doubt its quality and, therefore, not rely on it. Also, without time pressure, which they are potentially *not* as experienced with, because there is usually time pressure when they play, they might not consider TTF the best strategy. By trend, this is also indicated by the descriptive statistics. Taken together, no time pressure might be less similar to their real-world, every-day experiences and, thus, not promote the use of an intuitive strategy. In older players' self-efficacy was not related to dynamic inconsistency, or any other decision-making variable. It may indicate that for older players other factors than their belief in their own competence are more relevant. This interpretation is supported by the theoretical notion that older players should be better able to differentiate their ability from the effort invested or the task-difficulty (Nicholls, 1984). Relatedly, older players might be more inclined to evaluate themselves and decide in line with what their coaches would suggest, because of feedback and explicit rules in training provided by their coaches. This is also supported by their overall lower self-efficacy score.

Overall, there are theoretical as well as methodological reasons that might explain why self-efficacy was not linked to the decision-making process of developing soccer players in both age groups. Theoretically, the link postulated might not hold for developing players, because children differ from adults in the stability of their self-efficacy. While self-efficacy beliefs are formed and change in childhood and adolescence, they remain more stable in adulthood (Marsh, Gerlach, Trautwein, Lüdtke, & Brettschneider, 2007). Especially with a focus on the developing players being part of a highly competitive professional youth academy, it is possible that their daily experiences (i.e., whether they have trained well/badly in the last session or played well/badly during a game) might lead to more frequent changes of their self-efficacy (Bandura et al., 2001; Levi & Jackson, 2018). A recent interview study similarly suggests that talented player's evaluations of themselves change dynamically based on changing contexts (e.g., match scores, own performance, coaches instructions; Levi & Jackson, 2018). Therefore, perhaps it would be informative to take the change of self-efficacy scores over time into account, which could be observed in a longitudinal study. State-like conceptualizations and changes in self-efficacy due to success when performing a task should rather be considered for detecting a potential link between self-efficacy and the decision-making process of developing athletes in the future.

Developing Players' Self-Efficacy Was Linked to Motor Confidence

While young players' self-efficacy was not related to the decision confidence in the first and final option, it was related to motor confidence: The higher the players' self-efficacy the better players thought they would be able to execute the first or best option. Similarly, a study on the relation of self-efficacy, physical and cognitive decision-making performance also showed that the strength of self-efficacy solely predicted physical performance (Hepler & Chase, 2008). Based on the results obtained in the present study, developing players' self-efficacy seems to be closely linked to their motor execution (i.e., motor confidence) rather than to their cognitive decision making (i.e., decision confidence). In detail, results indicate further that decision and motor confidence are different constructs and this interpretation was supported by medium to high correlations between the constructs still yielding a high percentage of unique variance. A potential explanation for not finding a link between decision self-efficacy and decision confidence might be that they are both affected by more frequent changes during childhood. Another reason might be that self-efficacy was assessed as a more general, trait-like construct and not specifically related to the task, while decision confidence was task-dependent (i.e., assessed for the specific options generated in the task). A similar explanation has been discussed in studies not showing a relation between self-efficacy and decision-making performance (Hepler & Chase, 2008; Hepler & Feltz, 2012a). To test competing explanations, future studies could assess changes in (task-specific) self-efficacy and relate these to changes in task-specific decision confidence and motor confidence. Beyond that, more ecologically valid decision-making tasks, in which players have to generate options on the field as well as have to rate their decision confidence and motor confidence might be more appropriate to address the link in developing players.

In general, our findings with respect to the role of motor confidence are relevant, because decisions in sports need to be executed by the motor system, which is often neglected in rather cognitive decision-making studies (for an exception see Bruce et al., 2012; Vaeyens, Lenoir, Williams, Mazyn, & Philippaerts, 2007). Considering motor confidence in future studies might be a relevant methodological add-on to shed light on how cognitive decision-making processes depend on or relate to the motor skills of the respective decision maker. To better understand the complex interplay of cognitive and motor skills, as well as the specific relation to decision self-efficacy, decision confidence, and motor confidence would be important, especially from a developmental perspective. In particular, the role of motor confidence should be scrutinized. Manipulating motor confidence experimentally, i.e. by means of (false) feedback or (social) comparisons before or during the task, and testing the effects on decision-making processes could be a promising future direction.

Developing Players Adapted Their Decision-Making Processes to Time Pressure

Focusing on the understudied decision-making process of developing soccer players including option generation and selection, we showed positive age-effects and provide evidence that time pressure boosted decision-making performance. As predicted, within the present study older players, as compared to younger players, generated first options of higher quality and generated options faster, while decision quality did not differ between age groups.

The result that decision-making performance did not differ between high expertise older and younger players is similar to the results of Ward and Williams (2003) showing that elite players did not improve with age. The age-effects on generation speed are in line with results obtained in information search studies (Davidson, 1996). In sum, the present study highlights that considering the option-generation process and option-generation speed, in particular, can shed light on age-related differences in decision making.

Regarding time pressure, our results showed that developing soccer players generated significantly fewer options, with time pressure as opposed to no time pressure, that were at the same time higher in quality. Additionally, the options players selected under limited time were also better than options selected without time pressure. Unlike the effect of time pressure in a static information-board task (Davidson, 1996) where children did not use information more selectively with time pressure, the present study revealed that fewer options were generated in the dynamic soccer tasks with time pressure. The reduction of the total number of options during generation is in line with the study results of Belling and colleagues (2015) obtained with adult soccer players. In developing soccer players, the effect of time pressure on decision-making performance differed from what has been shown with adult soccer players (Belling et al., 2015a). While developing players adapted to limited time by prioritizing better options when deciding, a change in option and decision quality with limited time has not been shown in adults (Belling et al., 2015a). As Belling and colleagues (2015) provided players with 2.5 seconds more time (10 s) compared to the present study (7.5 s), this might have potentially resulted in a less prominent effect. Future studies should, therefore, use different time-pressure manipulations (e.g., 5, 7.5, 10 seconds) in a within-subject design to scrutinize the size of effects. Summing up, the results of the present study indicate that developing players adapted their option generation (i.e. the total number of options generated) in a similar manner like adult soccer players (Belling et al., 2015a) and also their decision-making performance profited from very limited time. In conclusion, that players adapted to time pressure in the present study is in line with predictions of ecological rationality (Todd et al., 2012).

Additional analyses revealed that developing athletes applied the TTF decision rule in a similar manner as adult athletes. Young players also selected their first option to be their best option in more than 50% of the trials and more often than options generated later, further demonstrating a meaningful, non-random strategy of option generation and selection (Hepler & Feltz, 2012b; Johnson & Raab, 2003). For the relation of the total number of options generated and dynamic inconsistency, empirical results have been inconsistent. While Johnson and Raab's (2003) study lent support, Hepler and Feltz's (2012b) study did not fully support this tenet. Within the present study, the more options younger and older players generated without time pressure the more inconsistent their final choice was with the first option, meaning that they selected another but the first option as their best option. However, with time pressure, only younger players were more inconsistent in their choices when they had generated more options, for older children this relation was not significant. This finding is interesting, because it indicates that, by trend, without time pressure and at a younger age, players relied less on their first option, which might be a disadvantage because the first option has been shown to be of higher quality (Hepler & Feltz, 2012b; Johnson & Raab, 2003; Raab & Johnson, 2007).

Generally, we believe that it would help to understand better when TTF is used and if not, *why not?* Maybe even focusing on people that never use TTF (cf., Raab & Laborde, 2011) or dynamic situations during which TTF is rarely applied will add to our knowledge base. Manipulating the environmental and situational structure systematically could provide further insight into such boundary conditions (Marasso et al., 2014) and provide a concrete anchor for tailoring training interventions (Buszard et al., 2013; Raab, 2012).

Limitations

The main limitation of the present study is potentially limited generalizability due to the sample selected. First, as we tested soccer players with high expertise for solving the decision-making test, it remains unclear whether the results can be generalized to other expertise levels. Future studies should test participants of different age *and* of varying expertise levels to quantify expertise and disentangle age and expertise effects. Theoretically, it is most important that participants have previous experience with a task for applying heuristics (Raab, 2012). This is why, based on the theoretical explanation and the empirical support obtained in this study, we are confident that the option-generation and selection processes postulated by TTF should generally hold for developing athletes of various expertise levels, though perhaps in smaller magnitude, as long as they are familiar with the sports task to solve.

Second, as we tested soccer players, the generalizability of results could be limited due to sport-specificity. Even if within the present study soccer players generated and selected options in a soccer-specific task, we argue based on theory that children will use TTF across a range of sports decision-tasks, with which they have gained previous experience (Raab, 2012). In addition, a recent study further supports the transfer of decision making across different sports (Roca & Williams, 2017). Thus, it is likely that the results obtained with developing soccer players will generalize to other team sports, which could be tested systematically in the future.

Conclusion

In conclusion, the present study demonstrates that the self-efficacy beliefs of developing soccer players were not related to their cognitive decision-making processes, namely to dynamic inconsistency, the quality of the first option generated and best option selected, or decision confidence but to their motor confidence. This indicates that considering motor components of decision making can contribute to the theoretical understanding of decision-making processes (Bruce et al., 2012; Raab, 2017). Furthermore, time-pressure and age effects have been demonstrated. With time pressure, players of both age groups generated fewer but better options and selected better options as compared to no time pressure. Thus, the present study is the first to quantify time-pressure effects in developing athletes and, thereby, can extend current theorizing on (the development of) decision making. Older players as compared to younger players demonstrated superior and faster option generation, indicating that the option-generation process should not be neglected (Belling et al., 2015a; Johnson & Raab, 2003). Taken together, our findings expand and specify the predictions of the TTF heuristic by quantifying the influence of time pressure and age on option generation and selection in sports. In the future, research should deepen our understanding of situational influences and examine time pressure and other situational constraints further, because this could help in tailoring decision-making training. To gain insight into *how* decision making in sports develops, a systematic comparison of different age groups and expertise levels (cf., Ward & Williams, 2003) as well as longitudinal studies will be important in the future.

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736 **Tables and Figures**

737 Table 1

738 *Relation of decision self-efficacy, decision confidence, motor confidence and decision making*
739 *in the younger and older age group*

740

	Self-efficacy of younger age-group	Self-efficacy of older age-group
Decision confidence in first option generated with time pressure	r = .184, p = .221	r = .070, p = .634
Decision confidence in first option generated without time pressure	r = .170, p = .260	r = .032, p = .827
Decision confidence in best option selected with time pressure	r = .074, p = .624	r = .070, p = .638
Decision confidence in best option selected without time pressure	r = .170, p = .258	r = .280, p = .054
Motor confidence in first option generated with time pressure	r = .295, p = .047	r = .328, p = .023
Motor confidence in first option generated without time pressure	r = .282., p = .058	r = .257, p = .078
Motor confidence in best option selected with time pressure	r = .269, p = .071	r = .343 , p = .017
Motor confidence in best option selected without time pressure	r = .360, p = .014	r = .315, p = .029
Number of options generated with time pressure	r = .201, p = .181	r = -.046, p = .754
Number of options generated without time pressure	r = .121, p = .421	r = .060, p = .685
Generation time of first option with time pressure	r = -.020, p = .894	r = -.181, p = .218
Generation time of first option without time pressure	r = -.298, p = .045	r = -.218, p = .137
Quality of first option generated with time pressure	r = -.124, p = .414	r = -.157, p = .286
Quality of first option generated without time pressure	r = .047, p = .756	r = 0.74, p = .616
Quality of best option selected with time pressure	r = -.182, p = .226	r = .011, p = .940
Quality of best option selected without time pressure	r = .074, p = .627	r = .051, p = .732
Dynamic inconsistency with time pressure	r = .095, p = .531	r = .071, p = .632
Dynamic inconsistency without time pressure	r = .334, p = .023	r = .156, p = .290

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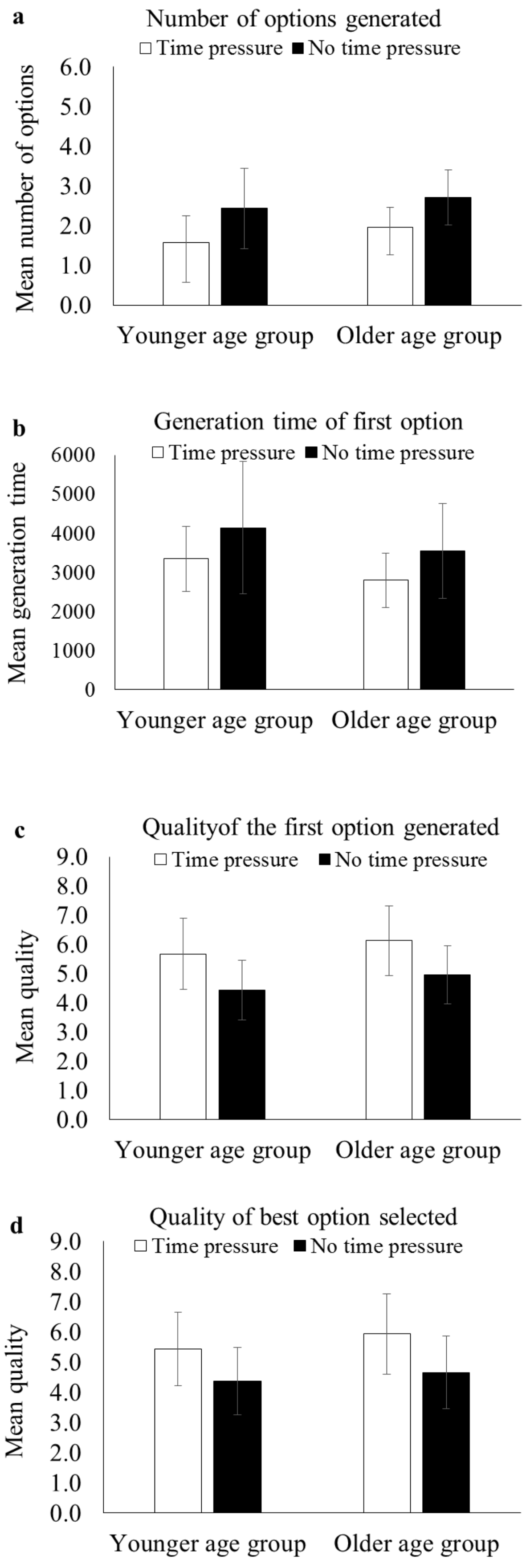

Figure 1. Time pressure and age effects on option generation and selection. Error bars indicate *SD*.