with the same quantum numbers as the scalar diquark current, hence it cannot mix under renormalization with any other operators. This greatly simplifies the task of determining the renormalization factor of the scalar diquark current. Composite operators typically require an additional renormalization beyond that of their component fields and parameters. In Chapter 5 the scalar diquark operator renormalization factor is determined to two-loop order by considering the correlation function

$$\Gamma^{d} = \langle\Omega|\, T\left[Q\,(x)\, J^{d}\,(0)\, q\,(y)\right] |\Omega\rangle\,, \tag{1.54}$$

where J^d is the scalar diquark current (1.53) and colour indices have been omitted for brevity. Conventionally the correlation in Eq. (1.54) is calculated in momentum space and the external quark propagators are amputated, in an identical fashion to the quark self-energy (1.44) However, in the case of Eq. (1.54) the scalar diquark operator is inserted with zero momentum. This is justified because renormalization factors are momentum independent. Then the renormalized correlation function is related to the bare correlation function by

$$\Gamma^{d}_{R}\,(q\,; m_R\,, a_R\,, \alpha_R) = \lim_{\epsilon\to 0}\left[Z_{\mathrm{d}}\, Z^{-1}_{\mathrm{2F}}\Gamma^{d}_{B}\,(q\,; m_B\,, a_B\,, \alpha_B)\right]\,. \tag{1.55}$$

Notice that this expression is identical to Eq. (1.48), apart from the factor of Z_{d}. This extra factor is the additional renormalization that is required in order to evaluate the limit in Eq. (1.55). This extra factor is precisely the scalar diquark current renormalization factor. In Chapter 5 the scalar diquark operator renormalization factor is calculated to two-loop order using Eq. (1.55).

Renormalized correlation functions explicitly depend on the renormalization scale μ. However, bare correlation functions which are calculated prior to renormalization do not. For instance, consider an amputated bare correlation function with $n = n_{\mathrm{YM}} + \tilde{n} + n_{\mathrm{F}}$ external gluon, ghost and quark propagators. Then the bare correlation function must satisfy

$$\mu\frac{d}{d\mu}\Gamma_B\left(q_1\,, q_2\,, \ldots\,, q_n\,; \alpha_B\,, a_B\,, m^i_B\,; \epsilon\right) = 0\,, \tag{1.56}$$

where q_i denote the momenta of each external propagator and m_i is to distinguish distinct